

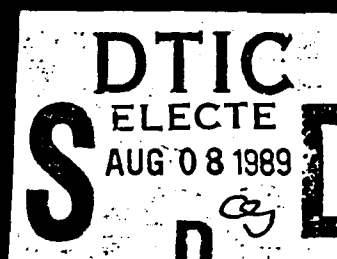
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A HISTORY OF WEST EUROPEAN ROCKETRY
AND SPACE RESEARCH

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DEDICATION

For Susan, Cole, and Connor who I love dearly and who have been my retreat through this journey.

And for my parents whose love has always been a source of strength.

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INTRODUCTION

Over the course of about the last 60 years, rocketry and space science has gained tremendous importance, not only with the two superpowers but with West Europe as well. The effects of this relatively recent science have permeated practically every aspect of our lives to include our human values, patterns of thinking, religious beliefs, moral philosophy, educational institutions and; concisely; our political, economic, and social attitudes and expectations. By its touching the very core of our existence, we have promoted, stifled, debated, taken shelter from, and expanded this field of science. It is in reactions like these that rocketry and space research and development, has had distinctive meaning for world politics; for from such reactions did political decisions come about.

The purpose of this ^{thesis} ~~paper~~ is to document and analyze steps taken by West Europeans in the rocketry and space field that have played a significant role in world politics and in the development of West Europe as a more integrated power. Through this chronological study, covering a period from the years immediately before the rise of the Nazis to power in Germany until the mid-1980s, ^{the author} ~~I intend to~~ portray the three most salient European nations, namely Great Britain, France, and West Germany, in their political roles with one another

and, to a lesser extent, with the two superpowers. It is also my intention for this study to act as a reminder that growth, economic well-being, and national security are the rewards of a continued, uninterrupted, generously-funded program of research and development that is organized for efficiency, that is well led, and that is staffed by well educated personnel.

It is not, however, my intent to cite all achievements and setbacks of West European rocketry and space science. Rather, I focus on those areas that I have found to be provocative and that provide not only some of the facts and figures but also the attitudes, expectations, and mindsets of disparate national involvements responsible for making the institutional, economic, social, and political changes that have affected the world.

I begin my history of West European rocketry and space research and development by focusing on the sudden transformation of this field from, basically, a meager civilian institution before 1933 to a military operation of monolithic proportions under Nazi Germany. It was during the Nazi rule that rocketry became prominent because of the military potential recognized in developing a ballistic missile as a tool to be used in achieving Hitler's goals. But the fissures present within the Fascist regime made research and development of Hitler's panacea weapon, the V2 rocket, an

exercise in hurry-up-and-wait repeated numerous times. There were extraordinary successes and breakthroughs achieved in missile technology, but Hitler's capricious attitude towards the rocket and his disregard for pure science bear truth to the inefficiency and disorganization of his totalitarian regime that stifled the V2's development and kept it from meeting its lethal potential.

In the second chapter it is my intention to show the "hand off" of the V2 rocket and its technology from the Germans to the Americans and Russians, and the consequences thereof. Essentially, this "hand off" accelerated the rocket and space developments of the two superpowers that eventually contributed to the Cold War and began the "space race", an era that caused anxiety throughout Western Europe that had significant political consequences, not least of which was a transition by West Europeans to a more neutralist military stand at the loss of support for the United States.

It is also in the second chapter that I illustrate a resurgence of West European interest in rocketry and space after their recovery from the effects of World War II. In large part, it was President de Gaulle's fight against American "imperialism" while attempting to restore France to its former grandeur that sparked the French interest in space, setting the precedent for all future European space ventures.

De Gaulle recognized the importance of space commercialization and the impact it could have on nations developing greater economic power. For example, fallout from space research had made American industry able to make important technological breakthroughs in materials and equipment that revealed great marketability. It was for reasons of both prestige and commercial value, then, that the West Europeans were spurred into space in an attempt to compete with the American economic colossus while defending European sovereignty.

In their attempt to hedge the American lead in space technology, the West Europeans formed a well-intentioned but ill-conceived European Launcher Development Organization (ELDO). This organization was supposed to compete against the United States for rocket launcher services, but lack of organization among member states led to its demise and the Europeans were compelled to start over again.

In chapter three I discuss West European space developments in the 1970s and 1980s by documenting the recovery from ELDO and the establishment of several important institutions and programs, such as the European Space Agency (ESA), Ariane, and the European Research Coordination Agency (Eureka), that have placed the Europeans on a good footing for future space research and development. These successes have brought the Europeans considerable prestige plus

success in competing with the Americans in commercial space, especially with the Ariane rocket launcher program that competes directly with the American Space Shuttle for the world's satellite-launching market.

In this chapter I also make the point that it is the French who should take most of the credit for West European progress in rocketry and space and are the ones likely to continue the European initiative in the future. It has been their political will, financial investment, and unwaivering desire to remain politically and economically independent from the United States that has made France the European leader in space since the 1960s. Evidence of this trend is indicated in the recently formed joint European agency, Eureka, that was ushered in by the persistence of President Mitterrand and proclaimed as the counter to American's Strategic Defense Initiative (SDI).

In the course of this paper, a shift of superiority among nations in the rocket and space field is represented: from the Soviets and Americans wearing the crown in the first three decades of the 20th century, to the takeover by the Nazis in 1933, and back again to the Soviet Union and United States in the postwar years. But in view of many interesting and significant rocketry and space developments made by the West Europeans in the last 15 years, the tides could change again in favor of the West Europeans by the early part of the 21st

century. Then the United States could very well find itself defrocked as the dominant player in a lucrative market of extreme political significance.

CHAPTER I

The V2 Rocket

Before World War II

Three persons were particularly significant in the transition from the small rockets of the 19th century to the colossi of the space age: Konstantin E. Tsiolkovsky in Russia, who, beginning in 1903, preached the possibility of travel in space; Robert H. Goddard in the United States; and Hermann Oberth in Germany.¹ While Tsiolkovsky and Goddard are considered the fathers of the respective Russian and American achievements in rocket technology, Oberth, the Hungarian-born German, might also be given the same distinction for Germany, if not for West Europe as a whole.² It is apparently Oberth's publication in Germany, in 1923, of Die Rakete zu den Planetenraumen (Rocket into Planetary Space) that not only gave new life to Tsiolkovsky's basic theory of rocket propulsion developed in 1898, but it also elaborated in great detail the application of rocket propulsion to spaceflight, thus providing a significant base upon which subsequent German military rockets were developed.³

Momentum picked up in rocket research in the following years. In the face of the first successful liquid propellant rocket, which was launched by Goddard and flew 56

meters in 2 1/2 seconds at Auburn, Massachusetts, on 16 March 1926, the German amateur rocket society, Verein fur Raumschiffart (VFR),⁴ was founded in Berlin in 1927.

Interestingly, it is through this amateur rocket club that we find, perhaps, our first "brain drain" as it relates to spaceflight. To realize this we need to focus upon the American sensation, Goddard, who, although being the champion of American rocket research, was suspicious of others and for the most part avoided open publication of his⁵ ideas and accomplishments.

So prolific was his output that those who followed could hardly take a step without in some way infringing on one or more of his patents, a fact recognized by the United States government when in 1960 the military services and the National Aeronautics and Space Administration awarded \$1,000,000 to the Goddard estate.⁶

For these reasons, one of the founders of the 1930 American Interplanetary Society wrote:

"When Goddard in his desert fastness in New Mexico proved uncommunicative, those of us who wanted to do our part in launching the space age turned to what appeared the next best source of light: the Verein fur Raumschiffart."⁷

It is not my intention to exaggerate the "magnetism" of the VFR, and I use the phrase "brain drain" very lightly, but this rift within American rocket research coupled with economic problems during the Depression help explain the relative decline of American rocketry from around 1930 until 1945,

compared to a more serious undertaking by the Germans during the same period. In fact at least one source states that it was only in the Soviet Union and Germany that dreamers of space travel, such as Tsiolkovsky and Oberth, were given much official encouragement during the interwar years.⁸

By 1930 the German army was only paying lip service to the Treaty of Versailles, which forbade the German Reich any modern weapons (the Reich looked for modern ones not covered in the treaty clauses), and felt confident enough to direct its interests into any novel fields of research which might have a military potential; included in these interests was rocket research.⁹ Therefore, in April 1930 the thirty-five-year-old Captain Walter Dornberger was assigned to the Ordnance Branch of the army's Ballistics and Weapons Office to work on rocket development at the army's Kummersdorf firing range, fifteen miles south of Berlin.¹⁰ This, of course, meant government sponsorship and funding of rocket projects that would invariably receive the financial means to go above and beyond endeavors made by the VFR which was always hampered by a lack of money.¹¹ Up to this point, rocket research had been in civilian hands, but now research would be shared with the military, at least for a few years.¹²

In 1933, however, upon Hitler's assumption of power, the Gestapo moved in, and overnight the VFR ceased to exist.¹³ To the new Nazi regime, it was inconceivable that a group of

civilian enthusiasts should publicly be working on an aspect¹⁴ of research which showed great military promise. Hence, rocket research became a military secret, consistent with the¹⁵ rapid, but still secret, armaments expansion.

In this same year, Wernher von Braun joined Captain Dornberger in developing the army's first stabilized liquid-fueled rocket, called the Aggregate 2 (A2), successfully¹⁶ launched in 1934. With this step, the Germans had drawn level with the only other serious rocket challengers, the largely-independent American, R.H. Goddard, and the Soviet Union, which had successfully launched its first liquid-propelled rocket in 1933.¹⁷ It is from this point, then, that German rocketry went ahead of American research, and not just in relative terms, for Goddard could hardly keep pace working in isolation, with meager funds from the California Institute¹⁸ of Technology. It is, however, more difficult to compare German advances with those of the Soviet Union after 1934 because, like the German's research, the Russian rocket research also became shrouded in secrecy. Nevertheless, it is reasonable to surmise that the Russians maintained a vigorous rocket program as evinced by the fact that it was the Red Army, not Nazi Germany, that used rockets first (tactically,¹⁹ on the battlefield) in World War II.

Despite von Braun's actual signing of a research contract with the army on 1 October 1932, with all the implications

that military affiliation would seem to suggest (research and development on weaponry, namely rockets, for one), it is stated that von Braun's original rocket plans were for peaceful purposes, possibly the speeding-up of long-distance postal services or space travel.²⁰ But the Nazi regime had more ominous intentions for products developed from the rocket program. With Hitler's jingoistic overtones, calling, for example, for his Four-Year Plan to be launched in 1936 to place Germany on a substantial war footing as a measure to prepare for his ubiquitous international goals, the notion of rockets used in battle became more than just curious prattle. It was agreed in the German High Command, for instance, that in the First World War aerial bombing had come to seem the best way to launch a decisive offensive strategy, since mutual slaughter by rifle and artillery appeared capable of infinite prolongation in slow trench warfare.²¹ That more credibility and importance was placed therefore, on a project that could possibly yield a new, impersonal, far-ranging weapon-from-above can be seen in the fact that in March 1936 official permission was given to build a new facility in a more remote part of Germany where research and launching could be conducted in greater secrecy.²² The new site, costing over 550 million Reichsmarks (paid for by a government grant), was called the Army Research Station Peenemunde, employing a 150-man research team, and located on the island of Usedom, just

off the Pomeranian coast, near the small fishing village of
Peenemunde, in what is today East Germany.²³

Actually, it is somewhat remarkable that Hitler allowed the new research facility to be built, given his social and economic concerns. Despite having few reservations about using military force to gain his international goals, he wished to avoid a properly planned war economy that would sap his resources and, therefore, possibly cause discontent if not chaos within the German society, as was the case towards the end of the First World War.²⁴ Hitler was, therefore, skeptical about the rocket as an operational possibility in the next war,²⁵ especially when considering the likely possibility of increased funding for the acceleration of its research while only hoping for successful development.

Hitler, however, had a passionate interest in weapons of a new and dramatic kind.²⁶ And although his enthusiasms were somewhat volatile, and were guided by his moods rather than by the opinions of technical experts, he allowed himself to be encouraged by German military leaders to pursue rocket development, for it was they who especially realized the significance of science in some very important breakthroughs during World War I, such as the development of improved explosives, poison gases, and synthetics.²⁷ Thus, coupled with the inspiration from the successful launch of the A2 in 1934, rocket research was allowed to continue with the

significant shot in the arm in its move to Pennemunde in 1937.

During the War

In the years leading up to World War II, the German rocket program made continuous advances, but it still did not share in the greater emphasis placed on the building of more conventional weaponry such as submarines, tanks, and aircraft. However, with the outbreak of war in 1939, Marshal von Brauchitsch, Commander-in-Chief of the German Army, enthusiastically supported weapons research and assigned the highest military priority to the rocket program.²⁸ This was short-lived, however, for in the spring of 1940, after successive military victories, with the collapse of France being the last conquest, Hitler brusquely intervened to reverse that decision for a reappraisal of all uncompleted projects.²⁹ In light of the rapid fall of his enemies with the use of conventional arms, Hitler saw little need to place much interest in unproven projects that would tie up essential raw materials and manpower. Indeed, rocket development was dropped completely from the priority ratings in August 1940, and many of the rocket scientists and technicians were called up for regular army service in preparation for the invasion of Britain.³⁰ Hitler simply figured that once his Blitzkrieg brought a "quick" end to the war, the "bookworms" could go

back to their work. Obviously, the rocket program suffered a setback and, clearly, the war was not a "short" one.

In this anecdote, Hitler revealed his blatant disrespect for pure (theoretical) science. And although he perceived technology (applied science) as a source of power and felt that the Germanic peoples deserved credit for its development, he also believed that, despite all man's technological achievements, nature still had the upper hand.³¹ In the following remarks, paradigms of Hitler's ethos with regard to science and education might help explain some of the reason why the German rocket program did not receive the utmost in support until midway into the war:

It was widely believed that Hitler said:
"Our national policies will not be revoked or modified, even for scientists. If the dismissal of Jewish scientists means the annihilation of contemporary German science, then we shall do without science for a few years!"³²

"...as necessary as chemistry, physics, mathematics, and such subjects may be in a 'materialisticized' (vermaterialisierte) era of technology, it is dangerous to devote more and more schooling to these disciplines."³³

Of utmost priority in education, Hitler declared, was the production of sound bodies. Second came character development. Least important was scholarly training, for, he asserted: "...a person less scholarly educated (gebildet), but with a good firm character full of decisiveness and will power is worth more to a people as a whole than a physically degenerated, weak-willed, cowardly pacifistic

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individual."

As irresponsible and brash as these statements may seem, we are able to see Hitler's ideology put into practice in the 1933 Civil Service Law. This law ousted Jews from government employment, and since a relatively large proportion of German university professors were Jewish and since academics were civil servants this had a devastating effect on academia. (In 1909-1910, 19 percent of the instructors at German universities were of Jewish origin, and the Jewish participation in the fields of medicine and natural sciences continued to increase up to 1933.)³⁵ Consequently, physics proved to be one of the most heavily affected disciplines, suffering a loss of at least 25 percent of its 1932-1933 personnel, including some of the finest scientists in Germany.³⁶ Twenty Nobel Prize winners were driven from their posts, and many of these had been awarded the prize before they left; with the exception of Gustav Hertz, all of them emigrated.³⁷ Included among the scientists who left Germany was, of course, Albert Einstein.

Another point that I believe bears significance in the following pages is that the German university population almost halved between 1932-33 and 1936-37 because of limitations placed on enrollment; but to be fair, birth rates were also lower in post World War I years, accounting for some of the decline.³⁸

It is not surprising, then, that on 20 January 1942, a memorandum, worked out by concerned German scientists, was submitted to the Reich Education Ministry in an attempt to regain support for science. ³⁹ The memorandum stressed that German physics had been overtaken by Anglo-Saxon (especially American) physics. ⁴⁰ It presented the decline of German citations in the leading journals of the world, contrasted by the growth of American citations, "indicating ⁴¹ America was performing increasingly significant research." Other arguments pointed out the growing number of Nobel prizes in physics going to Americans, and that the American Physical Review ⁴² was recognized as the leading journal of the world. Finally, reference was made to the relative decline of German nuclear physics research, as depicted in the comparative number of articles on the subject:

	<u>1927</u>	<u>1931</u>	<u>1935</u>	<u>1939</u>
Germany	47	77	129	166
USA and England	35	77	329	471

Adapted from Alan D. Beyerchen Scientists Under Hitler: Politics and the Physics Community in the Third Reich, (London: Yale University Press, 1977), 185.

How all of this influenced German rocketry is difficult to argue objectively. However, it seems reasonable to assert that the expulsion of such a high percentage of scientists and the decline of educational opportunities beginning in 1933 had

a detrimental effect on the rocket program, either directly or indirectly.

Nevertheless, subsequent to German military failures by 1941 coupled with Hitler's declaration of war on America on 11 December 1941, rocket research gained importance in Germany. Hitler reluctantly had to accept the transition from a Blitzkrieg to a general war and therefore was inclined to change his strategy. If he could knock out the United Kingdom and control the West, he could then concentrate on the East and smash the Soviets. However, just as Operation Sealion was not possible earlier, a landing operation on the UK was now less feasible. Therefore, Hitler planned to hit the British from the air again. Realizing that the Luftwaffe was not capable of the operation after the Battle of Britain, he was inclined to consider his secret rocket as an alternative. And now with Germany at war with America and with plans for a two-stage rocket (later called the A9 and A10) already in hand as of 29 July 1940, the concept of engaging America with the first intercontinental ballistic missile began to be seriously evaluated.⁴³

In the meantime, America was reevaluating its position:

As the events of 1941 and 1942 began to show how the war might develop, the advantage of having a European base became clear; the independence of the United Kingdom must be maintained at all costs. On the other hand, nothing must be done to antagonize Germany too much, otherwise this

would produce a definite German requirement for long-range rockets and nuclear warheads, and hence work on them would be accelerated. The longer America remained out of the war, the further advanced her own atomic research would be, whilst Germany's projects would proceed with only low priority.⁴⁴

One might be tempted to go along with this American strategy based on the fact that Germany more or less dropped nuclear research for military purposes by 1943. This, however, was due more to the sabotaged source of heavy water⁴⁵ than to any American military strategy. This strategy seems weak also when considering that on 3 October 1942 the A4 (Aggregate 4) was successfully launched:

It flew 120 miles along the Baltic coast, falling into the sea only 2 1/2 miles from its predicted impact point. At the height of 110,000 feet and Mach 5, it carried on as a ballistic missile, reaching the apex height of 60 miles. Reentering the earth's atmosphere at over 3,000 m.p.h., friction slowed it down to 2,000 m.p.h., at which speed it hit the sea.⁴⁶

On the day of its first active operation, then, the A4 was dubbed the Versuchsmuster 2 (Experimental Type 2) or more⁴⁷ commonly referred to as the V2. This, obviously, was an extremely sensational and important scientific breakthrough. Nowhere had such a feat been accomplished. The Germans had not only successfully launched the V2 but had also placed it out of the earth's atmosphere. This was phenomenal considering the characteristics of the rocket:

Length - 46 feet 6 inches

Maximum body diameter - 5 feet 5 inches

Weight empty - 7,270 pounds

Weight of warhead - 1,650 pounds

Weight of fuel - 20,150 pounds

Total weight at launch - 29,070 pounds.

Adapted from Philip Henshall, Hitler's Rocket Sites, (New York: St. Martin's's Press, 1985), 11.

Therefore, it is not surprising that 3 October 1942 has been marked as "the first day of a new era in travel, that of the spaceship."⁴⁸ Certainly, von Braun was encouraged to refine the rocket for his long-dreamed-of purpose to "study the upper atmosphere and cosmic radiation" while progressing to⁴⁹ his ultimate goal of space travel.

The idea, however, of using the V2 for any other purpose than for the immediate purpose of winning the war was branded as defeatism by the Nazi regime as indicated in the following:

They knew that their Army Research Center - even though it was a military facility manned by civilians - could, must, and would be at the same time the birthplace of spaceflight. Because they knew this and were thinking along these lines, von Braun and his engineers Riedel and Grottrup were imprisoned for a time in March 1944 by the Gestapo. They had done nothing more than speak of their plans, of earth satellites and space vehicles of the future, at a meeting in Zinnowitz.⁵⁰

Again, the Nazis stifled progress towards space research if not development of the V2 for their own military purposes.

Regardless of the successful flight of the V2, Hitler still refused to invest scarce manpower and materials in such a costly and uncertain enterprise, especially at a time when the Russian campaign had made his need for tanks and planes more desperate than ever.⁵¹ (At the height of production, each rocket cost about 56,000 Reichsmarks, and over the project as a whole each cost 250,000 RM.)⁵² Early in 1943 he allegedly told Albert Speer, "I have dreamed that the rocket will never be operational against England. I can rely on my inspirations. It is therefore pointless to give more support to the project."⁵³

But after the loss of Stalingrad on 2 February 1943, Hitler changed his mind again and personally renewed interest in long-range weapons.⁵⁴ This time he had Dornberger and von Braun come to his headquarters in July 1943 to show him a film of the successful 1942 launch, after which Hitler told Dornberger he had been wrong in failing to appreciate the work earlier and said that if the weapon had been available in 1939 the war would never have started.⁵⁵ The possibilities of the V2 seemed to provide the answer for winning the war that was bleeding the German army conventionally; therefore, top priority was again placed on the project.⁵⁶ As a matter of fact, Hitler now apparently came around to realizing the importance of scientists in research rather than on the battlefield, for on 29 July 1943, a planning board to

determine research priorities and to withdraw scientists from battle was created.⁵⁷ However, according to a postwar British intelligence report, only 4,000 of 6,000 scientists scheduled to be withdrawn from the fighting could actually be recalled; 2,000 had already been killed or could not be located in the spreading confusion.⁵⁸

Nevertheless, it was at this point that the V2 received unprecedented support in terms of both material and manpower and as a propaganda tool used by Goebbels and others. Because of the mass bombings of German cities by the allies, Albert Speer in September 1943 publicly promised retribution against these attacks by a "secret weapon."⁵⁹ A year later, on 5 September 1944, the first offensive shot of a V2 penetrated into enemy territory along a guidance beam directed at Paris from a site south of Liege, Belgium; and three days later came the official start of the offensive on London that provided the opportunity to rename the V2 the Vergeltungswaffe 2 or Revenge Weapon 2.⁶⁰

To what degree morale in Germany increased, if it increased at all, as a result of sensationalized publicity of the V2 offensive is difficult to say since it is so subjective. Certainly, there were those whose confidence or hope for a German victory was strengthened, but there were also many who saw the V2 as a device to prolong an inevitable defeat. And there were still others who hoped the V2 would

fail to turn the war around in favor of the Germans, as exemplified by one rocket that, after being assembled in the underground caves in the Harz Mountains (research was conducted at Peenemunde while mass production was done in the Harz Mountains), carried the hammer and sickle, the Star of David, and slogans "Red Front'" and "If we win, God help the
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Germans."

Objectively, however, the V2 effectiveness is probably easier to assess. Despite his protests, Dornberger's superiors ordered the immediate use of the first 300 V2s assembled by the summer of 1944, evidently without giving due regard to the fact that as of January 1944 there was a large percentage of launch or flight failures (around 40 percent)
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the causes of which still were being worked on. Thus, from the beginning of the V2 offensive until 27 March 1945 when the Germans ended the assault, faults still plagued many of the 4300 V2 rockets that were fired; 1,403 were fired at targets in the United Kingdom, of which 1,115 were launched
63
successfully. Not only were there problems with successful launching, but the navigation system was never completely resolved. Although required accuracy called for impact within half a mile of the target area, the rocket rarely got within
64
an eleven-mile radius of the target.

Based on the launch and navigation statistics and despite the speed for which there was no way to counter it, the V2's

contribution to the German war effort puts the whole project down to being an expensive, time and resource consuming exercise, which produced very little military effect.⁶⁵ And, as alluded to before, within the context of the German economy, its production interfered with the production of more orthodox and proven weapons.⁶⁶ For the money it cost to mass produce each of these rockets (250,000 Reichsmarks) at least six high-performance fighters could have been built.⁶⁷ And the complex electrical equipment of the V2 retarded the production of vital electrical equipment for U-boats, and the development of a more efficient radar system.⁶⁸

With the aspects of war aside, however, the V2 was a brilliant success. The fact that this rocket, weighing over 14 tons, was planned, developed, and successfully launched to penetrate outer space is testimony of a tremendous breakthrough in technology. The V2, in fact, was not only the first large rocket to see substantial service, but it also provided the base from which all modern space exploration stems.⁶⁹

Conclusion

Within the first 45 years of the 20th century, extraordinary advances were made that have shaped the way rocketry and space travel is conducted today. In the early

years, the independent rocket researchers placed theory into practice and continued to develop better and more credible rockets in quest of fulfilling their notions of speeding-up transportation and satisfying their curiosity of the upper atmosphere and space.

The Americans and Russians dominated rocketry in the first 30 years of the century, but when Germany realized the possible military significance of the rocket, the tables turned. Grants from the Nazi government gave German rocket research substantial financial backing while taking it out of civilian control. It was under this totalitarian regime that a full scale facility at Peenemunde was developed in pursuit of a secret weapon for possible use in the "next" war. But in spite of the obvious support for rocket research, the sometimes directionless regime vacillated in its commitment to the project and made significant errors that directly and indirectly hampered rocket development. Among these errors were the Civil Service Law of 1933 and, during the war, Hitler's ordering of some 6,000 scientists to battle. After significant military defeats and in response to reprisals made by concerned German scientists about the plight of German physics, Hitler had the scientists returned from battle and placed top priority on refining the V2 rocket that had been previously tested in 1942. Because of the urgency of development and the immediacy of use, the refinements sought

were never completely realized and, therefore, the uncorrected navigational system made the military effects of the V2 rather negligible relative to its potential. Therefore, the V2 as a revenge weapon was an expensive failure.

While the Nazis can take credit for the eventual, accelerated development of the rocket, they also must bear responsibility for stifling German science as a whole and allowing the Americans, at least, to outpace them in physics research, an American achievement that would place the United States on reasonably good footing in the development as a dominant player in rocketry and space exploration in postwar years.

In the following chapter, the war comes to a close, and the V2 rocket assumes a different role. Captured by the Russians and Americans for their own research, the V2 becomes the medium through which the Cold War is intensified and the "space race" is initiated.

END NOTES

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- 2 Ibid., 28.
- 3 Ibid.
- 4 Ibid., 29; and Philip Henshall, Hitler's Rocket Sites, (New York: St. Martin's Press, 1985), 12.
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- 8 Wright, 95.
- 9 Henshall, 12; and Ernst Klee and Otto Merk, The Birth of the Missile: The Secrets of Peenemunde, (New York: E.P. Dutton & Co., Inc., 1963), 11.
- 10 Henshall, 12.
- 11 Ibid.
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- 14 Ibid.
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- 16 Ibid.
- 17 Ibid., 14; and Newell, 29.
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Alan S. Milward, War, Economy and Society: 1939-1945, (Berkeley and Los Angeles: University of California Press, 1977), 197.

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- 42 Ibid.
43 Klee and Merk, 91.
44 Henshall, 118.
45 Wright, 104.
46 Henshall, 20.
47 Klee and Merk, 7 and 9.
48 Ibid., 111.
49 Ibid., 7.
50 Ibid., 7 and 111.
51 Wright, 96.
52 Milward, War, Economy and Society 1939-1945, 199.
53 Wright, 96.
54 Henshall, 116.
55 Henshall, 24; and Wright, 96.
56 Henshall, 24.
57 Beyerchen, 190.
58 Ibid.
59 Henshall, 128.
60 Klee and Merk, 47.
61 Ibid., 61.
62 Wright, 98; and Henshall 111 and 112.
63 Wright, 98; and Henshall 133.
64 Henshall, 95.
65 Ibid., 200.
66 Milward, The German Economy at War, 105.

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68 Ibid.

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Newell, 32.

CHAPTER 2

The Space Race

The V2 Rocket and the Early Postwar Years: 1945-1952

In the last months of the war in Europe, it became hopeless for the three V2 launching batteries to hold their positions in Holland in face of the allied advance.¹ Therefore, subsequent to the last V2 fired on 27 March 1945, they withdrew to Germany on 28 March 1945 only to surrender to the American Ninth Army on V-E Day, 9 May 1945.²

Meantime, the Red Army was closing in from the east. By March 1945, Army Research Center Peenemunde was overtaken, but not before 4,325 personnel employed at the facility were evacuated to five "safer" sites where rocket research was to continue.³ The leadership of Peenemunde were forced to establish new headquarters in the Bavarian Alps, first at Oberammergau and then at Oberjoch in Allgau.⁴ But by 2 May 1945, Werner von Braun and Army officer Walter Dornberger traveled in the direction of Reutte and surrendered to the Americans.⁵

A week later, the allies occupied all of Germany and the fighting was over. With that came the spoils of war that featured not only the V2 rockets but also the scientists thereof. The United States and Russia seized the opportunity

and took both rocket and builder. By the war's end, over 120 German rocket engineers had been gathered at Ft. Bliss, Texas, to work in the Army Ordnance Research and Development Suboffice.⁶ This, then, marks the point at which the "Wizard War", as Winston Churchill called it,⁷ came to an end, and the caldron of political tension between the two superpowers was kindled.

With the Potsdam Conference of July 1945, Germany lost its lease on any further rocket research and testing because the four occupying countries ruled that Germany must be disarmed. For that matter, in the aftermath of the war, Germany, like many of its neighbors, was far more concerned with the basic necessities for survival than with the pursuit of any "fanciful" research projects that might have military applicability. For more than a decade after 1945, West European governments' interest in rocket and space research was negligible if not nonexistent.

This, however, was not the case in the United States where there existed a more positive, yet a somewhat ambivalent, attitude towards rocketry and space exploration in the early postwar years. On the one hand, the American military had decided to concentrate on the existing manned aircraft fleet capability to deliver its nuclear might and not actively pursue the development of an intercontinental ballistic missile.⁸ On the other hand, a rocket program,

modest as it was, continued that eventually placed America into the "space race" of the 1950s, thanks in large part to German assistance.

On 26 September 1945 the United States launched its first⁹ rocket specifically designed for upper-air research. It was called the WAC-Corporal and rose to an apex of about 70¹⁰ kilometers, a U.S. record at the time. But relative to the superiority of the V2, whose altitude performance was 160¹¹ kilometers, the WAC-Corporal's record-making flight must have seemed somewhat anticlimatic. Evidence of this is suggested by the fact that with the recent acquisition of a large stock of captured V2s, focus on the vehicle for high-altitude research shifted to the German-designed rocket.

This shift became evident on 27 February 1946 when a meeting concerning high-altitude rocket research was convened that ultimately resulted in what came to be known as the V2¹² Panel. As the name implies, the V2 rocket played a dominant role in the research planned by this original forum of nine members, of whom van Allen is the best known for his discovery of the earth's radiation belt that now bears his¹³ name. All other members were from U.S. universities, military institutions, or the General Electric Company and were primarily interested in cosmic ray, solar, and¹⁴ atmospheric research. With modifications made to replace the German warheads with scientific-payload-carrying nose

sections, the V2 rocket was well suited for this study:

The V2's altitude performance of 160 kilometers with a metric ton of payload far exceeded that of any other rocket that the experimenters might have been able to use, making investigations well into the ionosphere possible from the outset. More significantly the large weight carrying capacity of the rocket meant that experimenters did not have to miniaturize and trim their equipment to shoehorn them into a very restricted payload, but could use relatively gross designs and construction. It permitted the researcher to concentrate on the physics of his experiment without being distracted by added engineering requirements imposed by the rocket tool.¹⁵

As an example of the crude instrumentation of experiments accommodated by the V2, one experimenter took an automobile headlight bulb, knocked off the tip, and used it as a Pirani pressure gauge to measure atmospheric pressure in the V2 fired on 28 June 1946.¹⁶

During the phase in which the United States launched the German-made V2s, advances in telemetering were made. Not only were the rockets equipped with instruments to measure different aspects of the upper atmosphere, but ground stations at the White Sands range for receiving and recording the data-bearing signals were erected.¹⁷ However, monitoring of the rocket's flight path remained quite unrefined until it became blatantly clear that a better method was needed:

Before the White Sands range was properly instrumented for tracking the V2s, von Braun, the director of launches, often watched the flying rocket as it rose above the desert, judging by the eye whether it

was on course. If the missile strayed, von Braun called for stopping the engines by radio. On one occasion, the eye failed to detect a tipping toward the south, and the missile landed in a cemetery in Juarez, Mexico, causing something of an international incident. Rumor had it that von Braun's lapse might have been related to his having some instruments riding on the rocket. At any rate preparations to track the missiles by instrument were accelerated.¹⁸

Despite some embarrassments, in the time between the first American launching of a V2 in March 1946 until the last one was fired in the fall of 1952, significant scientific progress¹⁹ had been made. Information on atmospheric temperatures, pressures, densities, composition, ionization, and winds, atmospheric and solar radiations, the earth's magnetic field at high altitudes and cosmic rays had been reaped, all of which were significant in advancing greater upper atmosphere²⁰ and space exploration.

Besides the palpable scientific data gained, the V2 program broke ground in political areas. With the accumulation of an array of answers to important questions that had previously been intractable, the V2 Panel gained²¹ attention from abroad. At the panel's 13 June 1950 meeting, Sidney Chapman, renowned geomagnetician from the United²² Kingdom, joined the discussions. From that time, international contacts gradually broadened as Chapman became a frequent participant and visitors from Belgium, Australia,²³ Japan, and Canada came. (By the 1970s, 94 countries or

international organizations were cooperating in some form with
the panel's spinoff - NASA, established in mid-1958.)²⁴

Unlike the Americans, in the early postwar years the Russians gave unequivocal support to their rocket program. This was largely due to their rudimentary air force and also because they had already demonstrated their ability to use rockets tactically in the war. They, therefore, saw in the rocket the means by which they could deliver their nuclear²⁵ bomb that they had developed by 1949.

Like the Americans, the Russians used their captured V2s and German scientists to supplement their rocket program. Their first V2 launch was from a range near Volgograd²⁶ (Stalingrad) on 31 October 1947. Less than eight years later, in the summer of 1955, their burgeoning rocket program, in which they spent a great amount of energy developing enormous rocket boosters, had made it possible for them to routinely test intermediate range ballistic missiles (IRBMs) capable of hitting targets 2000 miles away in Western²⁷ Europe.

Soviet Satellite Superiority and Western European Public Opinion

In this segment of the chapter I present the Soviet and American advances in rocketry and space research in order to establish the base from which a resurgence of Western European

interest in those areas stems. For it is in the wake of the Soviet and American space race that the West Europeans heightened their concerns for security and technological competitiveness that had a way of changing their outlook on world politics and inspired their own search into the outer atmosphere.

While the Soviet Union was well on its way developing an ICBM by the mid-1950s, the United States can only claim that a sizeable missile program was started once it had completed successful hydrogen bomb tests on 1 November 1952.²⁸ (The Soviet Union made their successful test of the H-bomb on 12 August 1953, but, as stated earlier, it had undertaken a serious rocket program from the outset of the postwar years.)²⁹ This had shown the possibility of constructing a high-yield warhead of low weight, low enough to make the rocket a feasible unmanned means of delivery.³⁰

Between mid-1953 and late 1956 the Soviet Union, having basically caught up to the United States in nuclear weaponry and being far ahead of the States in rocket development, set the stage for the infamous missile gap.³¹ World tension created by this was only exacerbated on 4 October 1957 when the Soviets successfully launched their first satellite, Sputnik I. Not only was this a scientific breakthrough, but it bolstered Soviet credibility with regard to the August 27,

1957, Tass announcement that an ICBM had been successfully tested in the USSR, an announcement that had aroused concern in some Western circles, but also a great deal of skepticism.³²

What had been regarded as a matter of science suddenly developed far-reaching psychological, political, and military implications.³³ Many people and their governments around the world - allies of the United States and neutrals, not least of which were the West Europeans - questioned the once indisputable reputation of the United States as the world's leading scientific-industrial-military power.³⁴ Underdeveloped areas, already predisposed to regard their problems as more akin to Soviet than American experience, were tempted to identify even more with the "backward Russians," who in the forty years since their revolution had achieved a technical feat unmatched by the United States.³⁵

By successfully launching Sputnik, the Soviet Union had given proof of the advanced states of its long-range missile technology, the publicity of which was viewed by many as part of the Soviet policy to weaken the West, especially NATO.³⁶ Indeed, publicity for the Soviet space program became the preferred Soviet form of "institutional advertising" as the following slogan exemplified: "Socialism is the reliable launching pad from which the USSR launches its spaceships."³⁷

And, not surprisingly, Khrushchev spearheaded the use of the space program for the Communist advertising campaign, albeit more through military intimidation than by friendly, civilian-sounding slogans. For example, he boasted in November 1957 that the USSR could launch as many satellites as it wished: "It is only necessary to replace the hydrogen warhead of an ICBM with the necessary apparatus."³⁸ Khrushchev was only publicly confirming that the technologies required for both civilian and military uses of outer space were essentially the same:

Basic to all applications is a device for propelling objects beyond the earth's atmosphere: the rocket booster. The character of the payload carried by the rocket and the flight path programmed for it determine its specific application-artificial earth satellite or ICBM, recoverable spaceship or bombardment satellite.³⁹

And after the Soviet's successful Lunik II earth-to-moon shot on 13 September 1959, Khrushchev continued his jingoistic rhetoric by boasting of being able to wipe from the face of the earth all his potential enemies with atomic and hydrogen bombs.⁴⁰

Throughout the Cold War period, both West European confidence in the United States and United States' self-confidence vis-a-vis the Soviet Union rested heavily on the assumption that the United States possessed and could maintain military, scientific, and technological superiority over its

principle antagonist. In the late 1950s and early 1960s many in the West believed, and not without cause, that the Sputniks and spaceships of the USSR were aimed directly at the heart of this assumption as evinced by the following excerpt of a book from that time:

If the governments and peoples of the Western Alliance could be induced to believe that (1) space capabilities are the major criteria by which the relative military, scientific, and technological strengths of the two sides should henceforth be judged, and (2) the United States is hopelessly outclassed in space by the USSR, then the Soviet leaders could reasonably expect to see a growth in neutralist and pacifist sentiments in Western Europe, together with tendencies in individual western governments to seek accommodations with the USSR outside the Western Alliance.⁴²

To give this assertion a more objective perspective, the following seven tables, with the exception of Table 2-1, reflect the opinions of several Western European countries with regard to the significance of the "space race."

Table 2-1 stands by itself to establish a base of general public awareness of Soviet success in launching the first satellite. From this table it becomes clear that a high percentage of the respondents were aware of Sputnik. In fact, at the time, the only other event in recent history that could match Sputnik in general public awareness was the explosion of the atomic bomb in 1945.⁴³ In comparison with popular reactions to other issues and events, these figures suggest

an unusual public appreciation of the significance of the
development of artificial satellites.⁴⁴

Table 2-2 illustrates an opinion poll administered in Western Europe in November 1957, after the Sputnik success, followed by another poll taken in October 1958, after the first American satellite (Discoverer I) was set into flight. The table reflects responses to the question as to whether the United States or the Soviet Union was ahead in scientific development. Interestingly, in November 1957 more Englishmen, Frenchmen, and Italians thought that Russia was ahead of the United States in scientific development; and only in Germany did the United States hold the lead and there by a small percentage.⁴⁵ But probably the most interesting finding is evidence of the extraordinary instability in these opinions as exemplified by the substantial change of percentages as a consequence of the American satellite program registering its first success⁴⁶ between November 1957 and October 1958. In Great Britain, the net shift was from 38 percent in favor of Russia to 13 percent in favor of the United States; in West Germany, from 4 percent in favor of the United States to 21 percent; in France, from 38 percent in favor of Russia to 14 percent; and in Italy, from 14 percent in favor of Russia to 3 percent in favor of the United States.⁴⁷

But when another opinion poll was taken in February 1960

Table 2-1

"Do you happen to know whether or not any country has succeeded in launching a man-made satellite around the earth?"
If "Yes," "Which country did so?"

(In Percents)

Country	Persons Who Knew Satellite Was Launched	Persons Who Knew Satellite Was Launched by Russia
Norway	97	94
France	96	93
Austria	93	92
Belgium	93	91
Germany	91	90
Italy	89	88
Canada ^a	83	83
Japan	79	78
Britain	74	73
Mexico ^b	71	67
Brazil ^c	57	51

Source: Joseph M. Goldsen, ed., Outer Space in World Politics, (New York and London: Frederick A. Praeger, Inc., Publisher, 1963), 74.

aEnglish-speaking population.

bMexico City.

cRio de Janeiro.

Table 2-2

"All things considered, do you think the U.S. or Russia is ahead in scientific development at the present time?"

(In Percents)

	Great Britain		West Germany		France		Italy	
Opinions	Nov., 1957 (800 polled)	Oct., 1958 (587)	Nov., 1957 (813 polled)	Oct., 1958 (1195 polled)	Nov., 1957 (802 polled)	Oct., 1958 (596 polled)	Nov., 1957 (807 polled)	Oct., 1958 (637 polled)
U.S. ahead of Russia	20	43	36	44	11	20	23	33
Russia ahead of U.S.	58	30	32	23	49	34	37	30
Both equal (volunteered)	6	12	15	19	16	33	21	21
No opinion	16	15	17	14	24	13	19	16

Source: Joseph M. Goldsen, ed., Outer Space in World Politics, (New York and London: Fredrick Praeger, Inc., Publisher, 1963, 76.

- five months after the Soviets placed Lunik II on the moon
- the Soviets came out on top again. This time the question
required respondents to estimate which country would have
the scientific lead in ten years.⁴⁸ The average favoring
the Soviet Union was 39 percent; the United States received
⁴⁹
only 28 percent.

Whether or not the responses to these polls were fickle
does not detract from the reality that the widespread popular
conviction regarding American scientific and technical
superiority was shaken and the expectations and attitudes that
were based on this conviction were also placed in question, as
⁵⁰
subsequent tables will indicate.

Table 2-3 also reflects two polls taken at the same
strategic points in time, after Sputnik and after Discoverer
I. The purpose of the polls was to obtain estimates of total
military strength of the United States and the USSR. In Great
Britain the change of responses between polls indicates
increasing favor for the United States as the military
superior while ultimately giving the nod to the Soviet Union.
On the other hand, West Germany lost favor in the United
States, dropping it by 14 percentage points, while the vote
for the Soviets remained the same. Many of the Germans who
had previously given the Americans the lead responded in the
"no opinion" category during the second poll, possibly
indicating either growing confusion with the times or opting

Table 2-3

"All things considered, do you think the U.S. or Russia is ahead
in total military strength at the present time?"

(In Percents)

	Great Britain		West Germany		France		Italy	
Opinions	Nov., 1957 (800)	Oct., 1958 (611) polled)	Nov., 1957 (813) polled)	Oct., 1958 (1739) polled)	Nov., 1957 (802) polled)	Oct., 1958 (624) polled)	Nov., 1957 (807) polled)	Oct., 1958 (635) polled)
U.S. ahead of Russia	19	26	38	24	17	19	34	38
Russia ahead of U.S.	50	41	23	23	25	28	22	23
Both equal (volunteered)	6	8	20	22	20	34	23	22
No opinion	25	25	19	31	38	18	21	17

Source: Joseph M. Goldsen, ed., Outer Space in World Politics, (New York and London: Frederick A. Praeger, Inc., Publisher, 1963). 79.

to be indecisive rather than "giving in" to the Russians. The French favor for either country remained nearly the same, but many who were once undecided estimated during the second poll that both were equal in military strength. Italy was basically unchanged in all categories.

With such diverse responses from each of the four countries, it is difficult to conclude any one attitude common to all. And it would be too simplistic to reason that perceptions of military strength went unchanged based on the assumption that West Germany and Great Britain balanced out one another while the relatively steady French and Italian responses caused no waves either way. It may, however, be reasonable to assert that the instability regarding science as seen in Table 2-2 had not thoroughly contaminated overall popular military estimates, and that satellite attainment had been viewed as only one component of military capability and had not had the effect of over exaggerating military strength.⁵¹ But again, when respondents in these countries

were asked to project their estimates of Russian and American military strength ten years ahead in a poll taken within the following two years, the Soviet Union came out ahead by an overall average of 34 percent to 28 percent.⁵² When these statistics are viewed in light of the responses documented in the following tables, it becomes more convincing that the

Table 2-4

"At the present time, do you personally think that this country should be on the side of the West, on the side of the East, or on neither side?"

(In Percents)

	Great Britain			Germany			France			Italy		
Opinions	May, 1957	Nov., 1957	Oct., 1958	May, 1957	Nov., 1957	Oct., 1958	May, 1957	Nov., 1957	Oct., 1958	May, 1957	Nov., 1957	Oct., 1958
Side of the West	53	58	49	66	63	63	28	21	26	46	42	31
Side of the East	2	2	2	--	--	1	4	3	4	4	5	11
Neither side	29	28	38	27	28	29	39	51	57	34	40	44
No Opinion	16	12	11	7	9	7	29	25	13	16	13	14

Source: Joseph M. Goldsen, ed., Outer Space in World Politics, (New York and London: Frederick A. Praeger, Inc., Publisher, 1963), 82.

Soviet lead in space had a clear impact on increasing the West European perception that the Soviet Union was the superior military power.

Table 2-4 reflects responses to a question asked during polls taken at three different times. The poll taken on May 1957 was timely, for then the Soviets were still about 3 months away from boasting of their first successful ICBM (although they had already been routinely testing their IRBMs). The significance of the other two poll dates have already been discussed.

Although there appeared to be a gradual decline of taking the side of the West, and probably even a more subtle shift in siding with the East, the more notable feature seems to be the increase in favor of neutrality as a consequence of Soviet missile and space developments. Whereas Germany only increased by 2 percentage points, Great Britain, France, and Italy had significant jumps in favor of taking neither side.

However, when the question was modified by the proviso "and if it should come to a war between Russia and the United States," a different pattern emerged.⁵³ Table 2-5 illustrates that the British boldly increased their already solid support for the United States. Italy also bolstered its taking sides with the United States by increasing from 31 to 36 percentage points (an increase of 16 percent). But its allegiance with the Russians also increased jumping from 4 to 5 percentage

Table 2-5

And if it should come to a war between Russia and the U.S.,
do you think this country should take a side or not take
a side? Which side?

(In Percent)

	Great Britain		West Germany		France		Italy	
Opinions	Aug., 1955 (800)	Nov., 1957 (800) polled)	Aug., 1955 (865)	Nov., 1957 (813) polled)	Aug., 1955 (800)	Nov., 1957 (802) polled)	Aug., 1955 (802)	Nov., 1957 (807) polled)
Side with Russia	—	2	1	1	5	3	4	5
Side with U.S.	47	57	40	41	25	15	31	36
Not take sides	39	33	45	48	51	62	45	49
No opinion	14	8	14	10	19	20	20	10

Source: Joseph M. Goldsen, ed., Outer Space in World Politics, (New York and London: Frederick A. Praeger, Inc., Publisher, 1963) 84.

points (an increase of 25 percent). The French appeal for either side dropped considerably, from 5 to 3 percentage points for the Russians and from 25 to 15 percentage points for the Americans, a downturn of 40% in either case, losses that were absorbed in the "Not take side" category. Germany remained relatively stable.

What seems to stand out is that where opinion was already pro-American, as in Great Britain, Sputnik produced an increase in American support when an actual war situation was specified.⁵⁴ Where opinion was already strongly neutralist, as in France, Sputnik produced an even more widespread neutralist reaction.⁵⁵ In Germany and Italy, where opinion had been more equally divided, Sputnik produced less if any change.⁵⁶ In other words, it appears that Sputnik tended to intensify trends already present in these countries.⁵⁷

In Table 2-6 yet another poll implied the weakening of American foreign policy in Europe as a consequence of Soviet satellite superiority.⁵⁸ Whereas Germany and Italy remained relatively stable in their responses from May 1957 to November 1957, both Great Britain and France showed a dramatic increase in the acceptance of U.S. and British troop withdrawal from the continent and Soviet withdrawal to within her borders.

However, when the question of confidence in NATO was raised, opinion on the whole showed unusual stability.⁵⁹

Table 2-7 indicates that pessimism about NATO's effective-

ness grew somewhat in West Germany and a considerable amount in Italy, but for the most part, attitudes toward NATO remained steady. France, albeit the least convinced about NATO's effectiveness of the four countries polled, actually presented an increase of confidence in NATO by October 1958. This, however, had probably more to do with the September 1958 ratification of the Fifth Republic's constitution and de Gaulle's assumption of power than anything else, despite subsequent withdrawal of France from NATO in 1966.

On the whole, the public-opinion trends examined hitherto reveal that there was a weakening of support for the security system of Western Europe and a strengthening of neutralist tendencies as a result of Soviet satellite superiority.⁶⁰

This weakening of the American position in West Europe was most pronounced in the field of science and technology, and then attenuated in estimates of general military capability,⁶¹ and in support of the Western European security system.

It was in opinion polls like these that the "space race" had distinctive meaning for world politics; for from such attitudes and expectations did political choices and actions flow.⁶²

Table 2-6

"Suppose the Russians suggested that (a) both the U.S. and Britain withdraw all their forces from the Continent and give up their bases, and (b) Soviet Russia withdraw its forces to within the borders of the U.S.S.R. Would you want this proposal accepted or rejected?"

(In Percents)

	Great Britain	West Germany	France	Italy
Opinions	May, 1957 (627 polled)	Nov., 1957 (800 polled)	May, 1957 (589 polled)	Nov., 1957 (807 polled)
Would accept	40	40	42	43
Would reject	40	30	19	24
No Opinion	20	20	39	33

Source: Joseph M. Goldsen, ed., Outer Space in World Politics, (New York and London: Frederick A. Praeger, Inc., Publisher, 1963), 85.

Table 2-7

"In the light of all you have heard up to the present time, how much confidence do you have in the effectiveness of NATO as a defense organization for Western Europe -- a great deal, some, not very much, or none at all?"
(Asked only of those who have heard of NATO.)

(In Percents)

Opinions	Great Britain		West Germany		France		Italy	
	May, 1957	Nov., 1957	Oct. 1958	May, 1957	Nov., 1957	Oct., 1958	May, 1957	Nov., 1957
A great deal or some	36	41	39	52	56	47	17	13
Not very much or none	27	26	28	22	15	22	22	30
No opinion	11	10	9	8	11	10	12	17
							12	14
							42	40
							26	26
							28	28
							12	12
							14	14

Source: Joseph M. Goldsen, ed., Outer Space in World Politics, (New York and London: Fredrick A. Praeger, Inc., Publisher, 1963) 87.

The American Comeback

To counter the impression made on the world by Soviet achievements during the "space race", the United States immediately took a series of steps to prop up its shaken position as the leader in the scientific and technological areas with expectations of scoring scientific breakthroughs that would in turn shore up U.S. clout in foreign policy:

- 1) The post of Special Assistant to the President for Science and Technology (later, the Office of Science) was announced.
- 2) Vast [financial] increases followed in the missile and then the space programs.
- 3) Both the House and the Senate established space and science committees.
- 4) The National Aeronautics and Space Administration (NASA) was created in mid-1958.⁶³

In contrast to the relatively meager funds provided in the early 1950s to the few groups engaged in rocket sounding research (a few hundred thousand dollars a year for each group), by the early 1960s the United States was spending \$5⁶⁴ billion a year on its space programs. Because of support like this, by the end of 1962 the United States had successfully placed into earth orbits 120 satellites, plus 6⁶⁵ into deep space. The Soviet Union, on the other hand, had placed 33 satellites into earth orbits, plus 4 into deep⁶⁶ space. This contrast in Soviet and American achievements

helped America regain some of its lost prestige and saw the political momentum shift in the U.S. favor by the late 1960s, culminating in the momentous historical event of America placing the first man on the moon in July 1969. Certainly, the Soviets tallied many of the notable "firsts" in space, namely the first manned orbital space flight; but the ultimate blue ribbon still went to the United States.

European Basic Problems

Before I begin to cite the steps taken by the West Europeans to get on board a serious space program, I find it essential to document some significant differences between the Europeans and Americans in terms of economics, research and education. For it was these differences that contributed to the technology gap of the 1960s that ultimately provided the impetus for a European space program.

I begin the examination of these differences by first referring to one of many interesting points revealed in Herman Kahn and the Hudson Institute's 1968 report on life in the year 2000. It predicted the leading powers in terms of per capita income: first, the United States; second, Japan; third, Canada; and fourth, Sweden.⁶⁷ The report then went on to place France, Great Britain, West Germany and all other Western European countries, the Soviet Union, Israel, East

Germany, Poland, Czechoslovakia, Australia, and New Zealand in
68
another category, representing less economic leadership.

This is somewhat interesting given the nine leading powers in terms of per capita income in 1967 were: the United States, Scandinavia, Canada, Germany, Britain, France, the U.S.S.R.,
69
Italy, and Japan.

Kahn's prediction of the United States coming in first while leaving West Europe far behind was based on several reasons, not least of which was the ubiquitous presence of American business in Europe. For example, in 1963, American firms in France controlled 40 percent of the petroleum market, 65 percent of farm machinery, 65 percent of telecommunications equipment, and 45 percent of synthetic
70
rubber, among others. American corporations in Europe controlled 50 percent of the production of semi-conductors, 80 percent of computers, and 95 percent of the new market for integrated circuits - miniature units crucial to guided
71
missiles and a new generation of computers.

Given these figures, there seems little reason to question General de Gaulle's reactions against what he viewed as the United States' intentions of world hegemony and why he advocated protectionist measures against American economic penetration and political influence. De Gaulle insisted that surplus American capital for investment gave the United States an unfair advantage in France and in Europe. As it turns out,

however, nine-tenths of American investment in Europe at that time was financed out of European sources.⁷² The American firms were simply making use of funds available to both them and the Europeans, just as Europeans do today in investing in the United States.

Another factor that contributed to American dominance in terms of economics that spurred technological progress which in turn multiplied economic success, was America's decisiveness in research investment that dwarfed that of its Atlantic neighbors. In 1965, for example, America spent a total of \$17 billion on research and development (R&D) while the Common Market spent only \$3 billion; Europe overall spent \$25 per capita on R&D as compared to America's \$94 per

⁷³ capita. To illustrate the significance of well-financed R&D, the following quote from Servan-Schreiber, the French journalist, is presented:

"...research programs not only speed up the pace of scientific discovery, but shorten the gap between the laboratory and the production line. This is the fundamental mark of the modern economy. From the moment of scientific invention until the manufacture of the product, the time lag was:

- 112 years for photography (1727-1839)
- 56 years for the telephone (1820-1876)
- 35 years for the radio (1867-1902)
- 15 years for radar (1925-1940)
- 12 years for television (1922-1934)
- 6 years for the atomic bomb (1939-1945)
- 5 years for the transistor (1948-1953)
- 3 years for the integrated circuit (1958-1961)⁷⁴

With a market hungry for rapid technological change, the Americans found the return on investments yielding high profits. The figures in Table 2-8 represent the estimated "technological balance of payments" in millions of dollars at official exchange rates. (The "technological balance of payments" of a country compares its payments to other countries for technical know-how, licenses, and patents, with its receipts for these items.)⁷⁵ France, West Germany, and Great Britain all had a pointed trade deficit of "technology" whereas the United States was clearly exporting far more "technology" than it was importing. The significance of America's enormous research investment and its tremendous returns from it is again summarized by Servan-Schreiber who states that "for large corporations there is a direct correlation between profits and the degree of advanced research: for the modern corporation, innovation is the major source of⁷⁶ profit."

Based on the figures in Table 2-8 and the comparison between the United States and Europe in R&D expenditures in the mid-1960s, it would appear that the Europeans were relatively unconcerned with or did not know how to go about establishing innovative programs of research and development. True, research funding in Europe was relatively meager at the time, but it would be out of line to suggest unconcern or lack of know-how as a reason for a slump in technological progress.

TABLE 2-8

Estimated "Technological Balance of Payments"
(in millions of dollars at official exchange rates)

<u>Transactions with</u> <u>all countries</u>	<u>Receipts</u>	<u>Payments</u>	<u>Balance</u>	<u>Ratio of pay-</u> <u>ments to receipts</u>
United States, 1961	577	63	+514	0.1
France, 1962	40	107	-67	2.7
West Germany, 1963	50	135	-85	2.7
Transactions with U.S. only				
France, 1962	11	53	-42	4.8
West Germany, 1963	10	52	-42	5.2
United Kingdom, 1961	17	86	-69	5.1
W. Europe (including others) 1961	45	251	-206	5.6

Adapted from C. Freeman and A. Young, "Research and Development
Effort in Western Europe, North America, and the Soviet Union,"
Scientific Affairs Directorate, OECD (1965): 74.

TABLE 2-9

Nobel Prize Awards for Science, 1901-1963

<u>Physics</u>	<u>France</u>	<u>Britain</u>	<u>W. Germany</u>	<u>United States</u>
1901-1911	4	2	3	1
1911-1921	1	3	4	-
1921-1931	2	2	3	2
1931-1941	-	3	1	4
1941-1951	-	3	-	3
1951-1963	-	3	3	15
<u>Chemistry</u>				
1901-1911	1	2	5	-
1911-1921	3	-	3	1
1921-1931	-	3	4	-
1931-1941	2	1	4	3
1941-1951	-	1	3	4
1951-1963	-	6	2	5
<u>Medicine and Physiology</u>				
1901-1911	1	1	4	-
1911-1921	1	-	-	1
1921-1931	1	2	1	-
1931-1941	-	3	3	5
1941-1951	-	3	-	8
1951-1963	-	6	1	14

Adapted from Robert Gilpin, France in the Age of the Scientific State, (Princeton, University Press 1968), p. 31.

Based on the statistics found in Table 2-9, it seems reasonable to cite the effects of World War II as one of the key reasons for any European decline in scientific innovation. Clearly, France, Great Britain, and Germany either met or exceeded the United States in awards in every category up until about 1951. After that, only Britain seems to have contended with the U.S., and possibly for good reason. Although Britain was severely damaged by the war, its political make-up had not been ravaged or placed in question like that of France and Germany's. Britain was in a better position than its two counterparts to nurture scientific growth based on sound government backing, despite the fact that all three countries' national percentage shares of government-financed R&D was nearly the same: West Germany, 27 percent; Great Britain, 30 percent; and France 33 percent.⁷⁷ (The United States government contributed 77 percent.)⁷⁸

Provided there was a technological gap between the United States and West Europe in the 1960's, it was only exacerbated by institutional and cultural differences. In America, dynamism could be traced to the social mobility, the individual responsibility, the equalitarian thrust of American life, and, above all, to the determination to invest in human beings, especially through the promotion of education.⁷⁹ In Europe, hope of closing the gap rested in genuine

democratization and genuine unification on all levels; it rested in the reform of education, the rejection of inherited social and intellectual rigidities, and the modernization of organization.⁸⁰

Taking a closer look at education, Europe was clearly behind the United States. In 1966 there were 78,000 college graduates in science from the U.S., or 3.9 percent of those in their age group. In the Common Market, with nearly the same population (190 million) as the U.S. in 1966, there were 25,000 graduates with degrees in science, or 1.1 percent of those in their age group.⁸¹

Chances for higher education was not equitable among Europeans. In France in 1966, for instance, workers formed 56 percent of the population, but their children represented only 12.6 percent of the students.⁸² In the United States, on the other hand, from three to five times as many children of workers and farmers had access to higher education as in the Common Market countries.⁸³ Such problems, although not common to such an extent in all EC countries, would suggest difficulty for Europe to contend competitively with the United States in any sort of scientific and economic progression.

In France, however, great strides were made to overcome their education problem. Partially because of the unprecedented population growth, between 1950 and 1960 the percentage of new teachers in France was the highest in the

world: a 126 percent increase for secondary school teachers, and 102 percent for teachers in lycees--against a 75 percent increase in the United States.⁸⁴ For university professors, the French growth rate was also the highest: an increase of 131 percent, against 58 percent in the United States.⁸⁵

To place the significance of education in the proper perspective with regard to scientific and technological progression, the respective quotes from Edward F. Denison, connected with the U.S. National Council on Economic Development, and from Servan-Schreiber follow:

"In the early part of this century, American economic expansion was basically a question of numbers. More than half of economic development in the period 1909-1929 was due to the expansion of the labor force and the growth of invested capital. Between 1929 and 1957 these quantitative factors were responsible for only a third of the increase in gross national product. Today the most important factors in economic expansion are education and technological innovation.⁸⁶

"The growing 'technological gap' between America and Europe is due primarily to a paucity of higher education, and thus to a relative weakness of science and research."⁸⁷

ELDO - The European Entry

With a background of the significant differences between the United States and West Europe established with respect to economics, research, and education, I now begin to cite the

measures taken by West Europeans in their attempt to enter the "space race."

First of all, the Europeans were well aware of the political significance and the possible economic spinoffs that were associated with space research. The conquest of space was viewed as having a great industrial impact on any nation or group of nations making the race.⁸⁸ Because of the "fall-out" from space research, American industry had been able to make important technological breakthroughs in refractory metals, computers (an area getting its start in Berlin in 1941 and subsequently taken over and dominated by the United States), and equipment for working in vacuums, not to mention the plans that were emerging to revolutionize intercontinental telecommunication via satellite.⁸⁹ In order to compete with the Americans, then, the Europeans began their own independent and joint space programs that proved, for the most part, to be well-intentioned but rather ill-conceived.

Actually, the real shove to get involved in the "space race" came from European businessmen who recognized the potential commercial market at stake. Three hundred European firms, representing more than 2 million wage earners, formed a group called Eurospace to encourage European governments to begin substantial efforts in space research.⁹⁰ In the manifesto drawn up for Eurospace, the industrialists said:

"The total space budget of all Western European countries combined, including

government programs and contributions to various organizations, is less than one-thirtieth of NASA's budget. Unless Europe makes a determined effort to catch up, commercial satellites of the type now becoming operational - telecommunications, televisions, meteorology, and navigation - will pass under American control for many years. ...A European abdication in an area of such importance would not only be an economic fact but a historic fact that would mark the beginning of her own self-willed decline. Billions of dollars in NASA funds started flowing into American industry more than two years ago. By 1970 a wave of American-built space equipment will inundate much of the world. We have to recognize that, aside from certain scientific experiments, no single European nation can carry on a major space program. Joint action is essential.

"A joint program should include all areas of space technology. The financial effort needed to carry out such a project will be made only if there is total coordination to eliminate oversights and duplication. This is what NASA does in the United States."91

Tied up in the commercial interests of industrialists to join the "race", there was pressure on the European governments to deal with a growing social crisis, in good part because of space research. European scientists and engineers were leaving for America in droves because of better opportunities in wages and work. As a result, Europe experienced a "brain drain", as Table 2-10 indicates.

Of the 4,868 total scientists and engineers from around the world who emigrated to the United States between 1956 and 1961, France, Germany, and Great Britain contributed 1,168 or 24 percent. But it is interesting to note that although

TABLE 2-10

MIGRATION OF SCIENTISTS AND ENGINEERS TO THE USA

Country of last permanent Residence	Immigrants into the USA (Annual average 1956-61)			Immigrants as a ratio of 1959 Output of Science and engineering graduates		
	Scientists	Engineers	Scientists and Engineers	Scientists	Engineers	Scientists and Engineers
France	26	56	82	0.5	1.2	0.9
Germany	124	301	425	6.0	9.8	8.2
Netherlands	34	102	136	7.9	21.8	15.1
United Kingdom ..	155	507	661	2.6	17.2	7.4
Total "Western Europe"	339	966	1,304	2.5	8.7	5.4
Austria	23	43	67	..	10.9	7.0
Greece	14	50	64	3.6	20.7	10.2
Ireland	13	32	45	4.7	15.4	9.3
Italy	29	42	71	0.9	1.7	1.3
Norway	6	72	78	3.4	23.8	16.2
Sweden	8	97	106	1.3	16.3	8.8
Switzerland	38	96	134	10.6	22.4	17.0
All Europe (including others)	549	1,684	2,233
Canada	212	1,027	1,240	12.5	48.0	32.3
All countries ...	1,114	3,755	4,863

Adapted from C. Freeman and A. Young, "Research and Development Effort in Western Europe, North America, and the Soviet Union", Scientific Affairs Directorate, OECD (1965): p. 76.

France did contribute to this drain of scientists and engineers, the number of French emigrants as a ratio of 1959 output of science and engineering graduates was the least of all listed countries - only 0.9 percent. And England and Germany exceeded the French contribution by 700 and 800 percent respectively.

The reason for France's relatively small exodus of scientists and engineers to the United States may have been President de Gaulle's advocacy of nationalism and blatant criticism of an "imperialistic" America. In a speech on 5 February 1962, de Gaulle revealed his quest to maintain French cohesiveness, as he watched other countries' scientific "brain power" become attracted to the generous offers of employment made by the United States:

"France, throughout her existence, has passed through periods in which the general process of evolution demanded a regeneration on her part, under penalty of decline and death... This is certainly the case today, for the age in which we are living--marked as it is by the acceleration of scientific and technological progress, the need for social betterment, the emergence of a host of new states, the ideological rivalry between empires--demands a vast regeneration both within ourselves and in our relations with others. The problem is to accomplish this without France ceasing to be France."92

Nevertheless, in 1962 France had only 6 research workers for every one-thousand citizens compared to West Germany with 7.3, the United Kingdom with 11, and the United States

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with 23.3. De Gaulle was obviously dissatisfied that France was on the wrong side of the technology gap, along with the rest of West Europe, and therefore continued his pointed rhetoric in support of French, and to a lesser extent, European advancement.

The economic and social pressures associated with the "space race" seemed to be mounting. Therefore, in 1961 the British took the initiative to put Europe on a space-research footing by introducing the "Blue Streak."⁹⁴ This was an outmoded missile that was originally conceived for military purposes but was now proposed by the British to act as the start of a European commercial satellite-launching program.⁹⁵ A European launcher was considered necessary in order to eliminate the U.S. monopoly.⁹⁶ Therefore, France, West Germany, Italy and the Benelux countries took up the British offer of the "Blue Streak" rocket and agreed to finance the development of further stages of the rocket and to provide ground-base tracking facilities.⁹⁷

Although the British appeared generous in their offer, their real motive was to get other Europeans to help the British fund a product that they were unwilling to continue to finance.⁹⁸ It was also hoped, although wrongly, that the rocket would help persuade President de Gaulle to allow Britain to join the European Community.⁹⁹ (This was not the only time that the British attempted to unload or at least

entice others to share the financial burden in a dying product: Rolls Royce was offered to Europe by the British just before it went bankrupt in the early 1970s.)¹⁰⁰

Nevertheless, the British found its partners for the "Blue Streak" rocket program and in April 1962 the seven nations signed an accord setting up the European Launcher Development Organization, ELDO.¹⁰¹

But almost from the beginning, this organization was destined to failure. There was no central authority that played the prominent role as head of the organization to make decisions for the common good of the program. Instead, each country worked separately on the scientific and technical problems of the operation, with almost no contact between officials at the international level.¹⁰² Many of the technical shortcomings and cost overruns grew out of this lack of integrated design and organization.¹⁰³

Another problem was that each of the participants immediately incorporated its assignment into its own national program because the financial share of various parts of the program had been worked out before the development contracts were signed.¹⁰⁴ The international character of the project was compromised, since each country was using its contribution to finance the part of the program it was conducting, and even to pay for purely national projects that were not part of the program.¹⁰⁵ The British, for example, soon perfected their

"Blue Streak" missile and used the rest of their budget to develop control equipment that was not included in the ELDO program.¹⁰⁶ The Germans devoted their ELDO contribution to developing ground testing facilities which would eventually be useful in setting up their own space program.¹⁰⁷ And there are similar examples for all the members of ELDO.¹⁰⁸

In the midst of these problems the French waived in their commitment to ELDO. With the rising cost of ELDO's budget, going from \$196 million to \$404 million, the French threatened to back out and devote their resources to their limited, but independent and very expensive, military program.¹⁰⁹ But because of de Gaulle's strong convictions to protect Europe from American hegemony, France remained in ELDO while pursuing other ways to undermine American "imperialism".

De Gaulle fought the Americans on the scientific front by trying to avoid technological research contracts with the United States. Instead he looked to the East. While the mainstay of his international science policy remained cooperation with France's European neighbors, by the mid 1960s he had signed scientific cooperation agreements with most of the Eastern European countries, as well as China.¹¹⁰ But most devastating to the Americans was de Gaulle's state visit to the Soviet Union on 22 June 1966 and his formation of close ties with the world's second scientific power as a means of balancing the scientific technical power of the world's first

scientific power, the United States.¹¹¹ In his speech at the University of Moscow, de Gaulle stressed the important role scientific-technical cooperation between France and the Soviet Union had to play in the rebuilding of l'Europe des Europeans.¹¹² And he agreed in principle to let the Russians launch a French satellite in 1971.¹¹³ (The first French satellite, the FR-I, was launched by the United States in the early 1960s.)¹¹⁴

In the meantime, the British too were feeling the effects of ELDO's problems. They were also experiencing the effects of their country's financial troubles in the mid-1960s. These circumstances, then, coupled with the maneuvering by the French with the communists, spurred the British to back out of ELDO in April 1968 to pursue their own satellite-launcher,¹¹⁵ "Black Arrow."

As for the Germans, they too saw problems with ELDO and decided to seek American help in pursuing their technological goals, thereby gaining contracts with the U.S. space program¹¹⁶ to build special equipment for probes of Jupiter.

What seemed to be a good idea in 1961 was now teetering on ruin by the end of the decade. ELDO limped into the 1970s suffering from the crippling effects of power politics economic upheaval, and self-inflicted disorganization. By this time the real "space race" was over.

CONCLUSION

From the early postwar years until the late 1960s, rocketry and space research progressed exponentially in the United States and the USSR, but was more or less a dilatory undertaking in West Europe, and not without good reason. In the aftermath of World War II, the Europeans were more concerned with the necessities than the extras in life. Indulging in programs outside of those based on basic survival and peace were considered illogical if not ludicrous.

The Americans and Russians, on the other hand, with sizeable caches of captured German V2 rockets on hand, saw an opportunity to continue the advances forged by the Nazis. The Americans, more bent on refining their renowned air force than developing a strategic missile, used the V2 as the primary vehicle for sounding the atmosphere, thereby developing a considerable data base for further space exploration. The Russians, however, not only accumulated useful data for subsequent space exploration, but also used the V2 as a testing vehicle in the steps taken towards developing the first intercontinental ballistic missile, publicity of which shook the world.

Subsequent to the success of the ICBM came the Russian launch of the first artificial satellite, the Sputnik I. It was then that American credibility as the leading scientific

and technological power was brought into question. Soviet satellite superiority caused the whole world to reappraise the superpowers, and the United States ultimately suffered a heavy loss of prestige that had a significant effect on its weight in foreign policy. Public opinion polls taken in West Europe revealed that there was a considerable drop in support of the United States among Europeans after Sputnik. This was reflected primarily in the substantial increase in the vote for neutralism, and, to a lesser extent, the drop in taking "the side of the West" and the increase in taking "the side of the East." The French tallied the largest vote for neutrality and the second largest vote for taking "the side of the East" among the four European nations (Great Britain, West Germany, France, and Italy) polled. Perhaps it was this national attitude that allowed de Gaulle to make his call on the Russians in the mid-1960s for cooperation in space exploration without being railed by the French electorate.

In any case, the American distinction as the scientific and technological superior had been shaken, but not without recourse. In an attempt to regain prestige, the American government established committees, institutions, and research programs, funded with billions of dollars, to hedge the Soviet lead in the "space race." Ultimately, the big race for the moon went to the Americans and, to a degree, respect was restored, although doubts about American

preeminence still remained widespread among Europeans.

In the midst of the "space race" between the two superpowers, the West Europeans, realizing the commercial spinoffs at stake, made their attempt to join in. Their hope lay in the British "Blue Streak" and the creation of the European Launcher Development Organization. But characterized by The Economist as "chiefly a dump for broken down military projects",¹¹⁷ ELDO seemed destined for collapse. Loose contracts and the lack of central control were part of the reason for cost overruns and the lack of integrated design that finally disillusioned member states and helped cause them to withdraw from ELDO, leaving the launcher organization in a state of disrepair by the end of the 1960s. Despite the attempt for a unified European effort to compete in the "space race," the decline of ELDO left the Europeans as polarized to one another in the field of space research as they had been before 1961.

As we turn to the last chapter of this study, I depict the West Europeans in their recovery from a sluggish start in the rocketry and space field that gave rise to the development of a truly integrated space program that has allowed them to stand up to the United States in the satellite-launching industry. With this success have come hints of even more aspiring joint European efforts that may cause us to wonder just how far the Europeans intend to

"go" in their expanding rocketry and space enterprise.

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CHAPTER 3

Europeans On the Rise

In the 1970s a real commitment to space research was made by West Europe. Institutions of firm foundation were established while space projects based on accumulating technical know-how through joint operations with the United States were initiated. Other programs were developed with the long-term goal of gaining independence from the United States in the space field.

In large part, it was the French who took the helm in leading the West European space initiatives of the last 15 years. And it was the successes of these initiatives that formed the base from which Europe today presents itself as a challenge to the United States in both space exploration and space commercialization.

The European Space Agency

Before I begin with the European triumphs of the 1970s, I believe I must dispel any notions, for which I am responsible, that the height of European progress in space research during the 1960s was the faltering of the European Launcher Development Organization. On the contrary, throughout the 1960s several steps were made by the

Europeans to place them on the proper footing for future space research. For example, not only in Europe but around the world new sounding rocket ranges appeared - at Woomera, Australia; Sardinia in the Mediterranean; Andoya, Norway; Jokkmokk, Kronogard, and Kiruna, Sweden; Chamical, Argentina; Natal, Brazil; Hammaguir, Algeria; Kourou, French Guiana; Thumba, India; Sonmiani Beach, Pakistan; and Huelva, Spain.¹ (For the most part, however, the United States was asked to come and use these sites rather than being used by the owners themselves.)

The Europeans made strides in other space-related areas as well. For example, those countries that could afford it went a step above the rather limiting sounding rockets and invested in scientific satellites that could remain in flight much longer and were capable of accumulating much more data. Great Britain, for example, developed the Ariel 1 satellite that, on 26 April 1962, became the first international satellite that NASA placed into orbit.² Similarly, on 15 December 1964 an Italian team built and launched the San Marco I satellite that flew on the American Scout rocket.³

The Italians also developed the San Marco towable platform which they anchored off the coast of Kenya, on the equator.⁴ This platform had special value in making it possible to launch satellites directly into orbits above the

earth's equator.⁵ For this reason NASA requested use of the platform for launching a number of U.S. satellites.⁶ With costs reimbursed by NASA, Explorers 42, 45, and 48 were sent up from the platform in 1970, 1971, and 1972.⁷

Despite the advances in space science made by the West Europeans in the 1960s, small as they were relative to those of the United States and Soviet Union, the breakdown of ELDO (as discussed in the last chapter) overshadows them. Because of ELDO's character as an international consortium with considerable political significance, its fall represented a shake in the process of West European integration. Had ELDO been a one-nation enterprise, publicity of its downturn would have been less, if not insignificant.

But before ELDO was allowed to go into total collapse,⁸ the European Space Agency (ESA) was formed in May 1975. This agency consolidated the activities of the European Space Research Organization (ESRO) and ELDO⁹ because it was recognized that a large part of ELDO's failure was due to a lack of design integration with ESRO which, for example, was supposed to provide the primary satellites for the ELDO launchers:

...the launching device - that is, the missile - had been agreed upon without any of the participating countries knowing what they were going to launch. There had been no discussion

with ESRO, which was making a study of satellites that might be put into orbit. By the summer of 1967 the use of the ELDO rocket by ESRO had still not been resolved. ESRO did not know whether or not the kind of satellites it was developing could be launched by ELDO, and reserved the right to choose American rockets to launch its satellites if their price and specifications were better.¹⁰

(ESRO was established on 14 June 1962 to complement ELDO in fostering the development of European technical know-how. It was composed of 10 countries - Belgium, Denmark, France, West Germany, Italy, Holland, Spain, Sweden, Switzerland,¹¹ and the United Kingdom.)

Although it was primarily France that urged the formation of the ESA, it was agreed by all member states that a serious European space program would require an integrated process involving a host of European countries. As it was in other European cooperative efforts, such as the Common Market and ELDO, the reasoning for support of the ESA was quite convincing:

...the imperatives of modern technology inevitably require closer European collaboration. In the emerging, promising areas of technology it would be opportune to begin developments on a European scale, before nationally-based interest groups emerge. European programs would ensure a larger scale of resources, thereby increasing efficiency; access to more than one national market, making possible longer production runs; and the sharing of investment costs and financial risks.¹²

Examining the situation somewhat cynically, there

appear to be two other very good reasons for France's zeal in the promotion of the ESA. First of all, it was the British and the French who had teamed up to spur interest in the "Blue Streak," leading to the formation of ELDO. Secondly, the French had been the largest financial supporters of ESRO, payments from whom accounted for 19 percent of its budget.¹³ Now if the French had allowed ELDO to completely collapse, with nothing to take its place, it was possible that ESRO would have fallen with it. Therefore, with many, already-spent Franks at stake, the French were practically compelled to promote the ESA in order to save face.

By shoring up support for the integrated European Space Agency, French prestige was bolstered, a larger market for their space-related products was ensured, and European strength against "encroaching" American technological advances was reinforced.

Today the ESA's goal is "to provide and promote, for exclusively peaceful purposes, cooperation among European states in the fields of space research and technology, with a view to their scientific purposes and for operational space application systems."¹⁴ Accepting this task are 13 member states (those that were members of ESRO plus Austria,¹⁵ Ireland, and Norway). Canada is not an ESA member but has an agreement for close cooperation with the agency and is

involved in some ESA programs; and Finland has expressed
16
interest in becoming an associate member.

The ESA is a Paris-based organization (as was ESRO) and
17
is the European version of NASA. As an example of its
integrated structure, it operates facilities all over
West Europe and throughout the world: 1) ESOC, the European
Space Operations Center, is in Darmstadt, West Germany; 2)
ESRIN, the European Space Research Institute, is located in
Frascati, Italy and operates the Information Retrieval
Service and the Earthnet Satellite program; and 3) the
European Space Research and Technology Center at Noordwijk,
Netherlands, is responsible for applied research in space
technology and for design, development, study, and testing
18
of spacecraft. The ESA also built the launch facilities
at Kourou, French Guiana, that now accommodate the highly
acclaimed Ariane rocket. (The next segment of this chapter
addresses Ariane in more detail.)

Obviously, with such an enterprising and pervasive
operation, the cost is sizeable, and it is expected to grow.
In 1985 the ESA's budget was \$1 billion; in 1986, \$1.2
19
billion; and in 1987, \$1.5 billion. Stacked up beside the
total Western European expenditure on space activities in 1986
20
(\$2.67 billion), the ESA accounted for practically half.
But compared to the United States, whose 1986 space projects
exhausted \$44.7 billion, the European commitment seems

rather small.²¹

Nevertheless, since the Apollo days the Europeans have made progress in narrowing the space technology gap that exists between them and the United States. In the period from 1965 until 1981 the shares of government-financed space research and development in the nine Common Market countries climbed from 3 to 16 percent.²² The United States, on the

other hand, dropped from 97 to 79 percent during the same period.²³ Despite the Europeans' relatively small

expenditure on space, the fact that their governments were contributing proportionately more of their budgets to space in 1981 than in 1961 indicates the establishment of a broader base of support and greater confidence in the space field. The significance of this is based on the idea that the main justification for government intervention is to overcome short-term barriers to get long-term benefits.²⁴

The manifestation of this idea is critical in most cases in the space field because long-term research is so far removed from immediate commercial advantage.²⁵

The increasing financial support for the ESA indicates a growing commitment to the agency, but there are problems that go along with these budget increases. Although the French seem eager to finance over one-third of the agency's budget,²⁶ the British are not inclined to invest so willingly. The following excerpt is the British response to

the French proposal for a European mini-shuttle, known as Hermes, that is priced at \$4 billion, twice the original cost:

The Thatcher government is opposed to any increases in Britain's contribution to the European Space Agency. It remembers an earlier high-tech dream, called Concorde, which eventually cost taxpayers 20 times what was originally proposed. Mrs. Thatcher said last summer [1987] that the private sector should put up the money to keep British industry abreast of the rest of Europe in space.²⁷

Another excerpt from the Economist further identifies the British mindset with regard to European space activities:

In the battle over money for space, France and Britain play familiar roles. France the senior member of the European Space Agency, is keen to spend and incites others to do so. Britain is skeptical. It wants a quick, down-to-earth return on any investment in space.²⁸

It was not only the experience with the Concorde that affected the British government attitude towards space projects. After the failure of ELDO's rocket, successive British governments gave relatively low priority to research and development, although British companies continued to play leading roles in the European consortia of space companies.²⁹

The West Germans are yet another matter. Of the three main projects facing the ESA - a new heavy-lift rocket called Ariane 5 (\$3.1 billion); the mini shuttle Hermes; and Columbus, a family of modules of which one will link up with America's space station (\$3.5 billion) - the Germans are³⁰ ready to support only the Ariane 5. They too are concerned about the increase of funds going towards space projects, as illustrated by one West German government official's comments:

"The behind-the-scenes work is in full swing to hammer out the package deal, but what is worrying us more and more is the spiraling costs of these programs. We're going to have to come to grips with this problem before it gets out of control."³¹

It is out of this confusion of who is for and who is against European space projects that President Mitterrand argued that Germany lacked neither the money nor the³² technology, just the political will to deploy them.

There were, however, top West German government officials who favored the ESA expansion. For example, besides fearing falling behind in high technology, Hans-Dietrich Genscher's Foreign Ministry has indicated that it was a bad idea for West Europe to let American satellites³³ do so much of its spying. And most enthusiastic of all was the late Mr. Franz Joseph Strauss, who wanted the expansion of the ESA to entail a German space agency along

the lines of America's NASA to be located of course, in
34
Bavaria.

But as emphasized throughout this segment of the paper, it was, and is, the French who have promoted and supported space activities like no other European country since the beginning of the postwar period. Servan-Schreiber claimed back in the 1960s that "France is the country that has shown
35
the most determination not to become a satellite"; its unwaivering commitment to space research and development attests to that. In the next segments of this chapter this assertion will become pointedly clear.

Ariane

In December 1965, President Johnson invited European countries to pool their resources in a major spacecraft
36
project to send probes into the Jupiter atmosphere. This plan was talked up as the kind of project that was sufficiently advanced to task both management and industry and was bound to advance European technology in important
37
ways.

Most Europeans found the project fascinating, but
38
showed skepticism about its ultimate usefulness. Moreover, the Europeans believed that the United States, and in particular, NASA, was seeking additional financing for

large-scale projects that Congress was no longer eager to support.³⁹ But there was also suspicion that America was

dangling the Jupiter probe in front of Europe to divert attention toward science and away from more practical projects like the communications satellites.⁴⁰ The French view towards such American offers was characterized by de Gaulle's declaration on 27 April 1965:

"To safeguard our independence-economic, scientific, technical - we must ensure that our activities remain under French direction and administration, even though we confront the enormous wealth of certain countries and although we will not refuse to carry out all kinds of exchanges with them. Likewise, we must support, no matter what the cost, those activities which assure the value, the autonomy, the very life of all our industry, those sectors which require the most research, experiment, and sophisticated tools or which need the largest team of scientists, technicians, and workers of the highest quality. Finally, when it is opportune in a selected branch to join our inventions and money and skills with those of another country, we must choose the country nearest to us and whose weight could not crush us."⁴¹

Other European leaders took a similar stand against America. Prime Minister Harold Wilson of Great Britain, for example, warned of "an industrial helotry under which Europeans produce only the conventional apparatus of a modern economy, while becoming increasingly dependent on American business for the sophisticated apparatus which will

call the industrial tune in the 1970s and 1980s."⁴²

Despite the opposition towards America by many Europeans, West Germany was interested in the American offer and, as stated in Chapter 2, accepted the cooperative project to probe Jupiter, while agreeing on other joint⁴³ undertakings with the United States. For instance, there was the project of the solar probe Helios that cost the Germans \$100 million for the satellites to support this sizeable endeavor that was launched toward the sun in⁴⁴ December 1974. As its share the United States provided⁴⁵ the two launchings required and some of the experiments.

Even if France and Britain had wanted to take part, their condition of tight finances in the mid-1960s would probably have precluded any serious joint effort with the Americans in space research. But the Germans, whose economy was flourishing and whose Defense Department was not consuming huge sums of public money to establish and maintain a nuclear force, were in a much better position to invest in the American ventures.

Certainly there were technological gains that Germany reaped in its cooperation with the United States, but probably more important, the Germans had helped establish a more receptive climate for joint American-European projects of an even grander scale, namely the Space Shuttle⁴⁶ project.

By 1970, with the race to the moon won, America shifted away from a manned space flight emphasis and toward unmanned application satellites.⁴⁷ NASA acknowledged in the early 1970s that the "aerospace depression" had clearly begun and⁴⁸ that the old days of "gung ho for space" were gone. In spite of this, on 5 January 1972, President Nixon made the announcement that the United States would start development⁴⁹ of the Space Shuttle.

The following year the European Space Research Organization (ESRO) was faced with the decision to join in the Space Shuttle program. Those countries that were once opposed to entering into joint operations with the United States took a second look at this project because the shuttle offered the opportunity to join in the development of a whole new technology. In the view of its promoters the shuttle would completely revolutionize space operations of the future, outdating and supplanting most of the expendable⁵⁰ boosters used in the 1960s and 1970s.

In September 1973, after a long-drawn-out, careful assessment of values and costs, ESRO agreed to participate in the Space Shuttle program by developing a manned laboratory - Spacelab, originally called a sortie module in⁵¹ the U.S. - to be carried aboard the Space Shuttle.

Although ESRO had made a contract to support the American shuttle program, it was still widely believed among

Europeans that the Americans, and Soviets, did not want West
Europe to become a real space power.⁵² Europeans were, for
example, still convinced that the United States would not
launch applications satellites for European countries if
these satellites appeared to compete undesirably with U.S.
industry - as communications satellites might do.⁵³

Therefore, in July 1973, two months before the signing
of the shuttle agreement, ESRO began development of the
Ariane booster rocket, with intentions of capturing a share
of the world market forecasted for launching commercial
satellites.⁵⁴ Since then, Ariane has met and surpassed all
expectations.

As a competitor against the Space Shuttle, Ariane has
had a very impressive record that has gained it prominence
as "the pride of all European space buffs."⁵⁵ For instance,
although development of the Space Shuttle began a year
earlier than Ariane, it was Ariane that made the first
flight into space in December 1979;⁵⁶ the Columbia shuttle
followed in April 1981. (Granted, the Space Shuttle, being
the world's first combination launcher/spacecraft with
reusable engines, was a much more complicated system to
build than Ariane, a "fire-and-forget" launcher). Moreover,
the cost of the 6-year Ariane development was marked at \$1
billion compared to the \$8 billion spent to build the first
shuttle.⁵⁷ To cut costs further, Arianespace, the private,

French company that manages Ariane, placed an order for 50 of the Ariane 4 rockets, which will keep them in stock until 1998.⁵⁸ This will make each Ariane launch cost about \$25 million, while it costs NASA \$36 million for a single shuttle shot.⁵⁹ This, of course, makes Ariane a more practical system than the shuttle as long as the mission only involves the "simple" launch of a satellite and no personnel since the current Ariane rocket is only designed for unmanned operations.

But if launching satellites is what Ariane is designed to do, it does it well. Of approximately 200 satellites to be launched in this decade, Ariane will claim a good share.⁶⁰ As of March 1987 it boasted an order book of 59 launch contracts, with a backlog estimated at about \$2.1 billion.⁶¹ Twenty-nine of these orders are from European companies, 11 from the U.S., and the remainder from Arab countries, Canada, and Australia.⁶² And Arianespace figures it will steal American customers from the U.S. government's picture-taking Landsat system, photographs from which are used, for example, in oil hunting and crop analysis.⁶³

The fact that Ariane is an unmanned system provides some of the reason why it has done so well in the satellite-launching industry. With no one riding aboard, instrumentation and insurance costs are relatively low. Therefore, despite 4 of 18 failures as of June 1986,

Arianspace is able to continue sending rockets aloft without making excessive delays for major shakedowns of the system, whereas the shuttle program experienced a two-and-a-half-year break in launches after its 25th shuttle launch blew up⁶⁴ in mid-flight on 26 January 1986. This shuttle breakdown resulted in a backlog of launch contracts that caused a shift of the satellite market to Ariane. This was accepted somewhat ambivalently by members of Arianespace, however, who saw the increase of contracts as an obvious financial plus but who also regarded it as an omen, foretelling an American response to try to regain the satellite-launcher market by reverting back to the standard expendable launcher.⁶⁵ So far there seems to be no evidence of this American reaction, however.

The success of the 208-ton Ariane rocket is largely attributed to the French government.⁶⁶ For of the \$550 million 1980 Ariane budget, which is administered under the auspices of the ESA (while Arianespace manages and markets Ariane), France contributed 63 percent while Germany paid 20 percent; Belgium and other European countries, 5.5 percent; and Britain, 3 percent.⁶⁷ It is not surprising, then, that the Centre National d'etudes Spatiales (CNES); the French, state-controlled equivalent of NASA; is the principle contractor for Ariane.⁶⁸

Another reason for Ariane's success lies in its launch

location of Kourou, French Guiana. Here, located on the Atlantic coast at 5° north latitude, the Arianespace-run Guiana Space Center can take full advantage of the extra velocity imparted to an eastward-launched rocket by the Earth's rotation.⁶⁹ From here an Ariane booster can lift 17 percent more payload than a similar booster launched from the Kennedy Space Center in Florida (28° north latitude).⁷⁰

Although the Europeans are very proud of their rocket that has given them a great deal of independence from the United States in the space industry, they have not become complacent in their successes. For now they are well on their way to begin the development of their own space shuttle called Hermes (again, under French direction). Herein lies the next challenge for the ESA and Arianespace; for to develop a European spaceplane that can in fact be placed into space, a new booster capable of carrying the larger load must be developed, unless the Europeans are willing to go back to the U.S. for launch services. Indeed, such a booster rocket is already planned to be launched by 1995 after the ESA gave the go-ahead in January 1985 for its development.⁷¹ It is called Ariane 5 and will have a payload lift capacity of 11,000 to 17,000 lb., an increase of about 4,000 lb. over the current Ariane 4.⁷² With this addition to their space inventory, the Europeans will be able to realize their dream of building their own space

station.

The progress being made in Western European rocketry and space programs has presented a good deal of competition and excitement between the Atlantic neighbors. In the next and last segment of this chapter, the goals planned by the ESA for their Ariane program will gain more meaning as America is seen challenging the Europeans once again in the field of space.

Eureka vs. SDI

During the 1970s, West Europeans displayed their desire for cooperation in rocketry and space activities through the successful development of the ESA and Ariane. From these successes a precedent was set that provided the momentum for Europeans to respond again in an integrated manner when they were challenged in the 1980s by American dominance in space and high technology. This time, however, it was a matter of military space defense and the European response to such.

Coming into office in 1981, President Reagan was troubled by the strategy called Mutual Assured Destruction (MAD), a concept supported by the Anti-Ballistic Missile (ABM) Treaty ratified by the United States Congress in 1972 and still in effect.⁷³ In particular, Article I of the treaty states, "Each party (that is, the U.S. or the

U.S.S.R.) undertakes not to deploy ABM systems for defense of an individual region except as provided for in Article III of this treaty." ⁷⁴ (Article III allows the United States and the Soviet Union to deploy one ABM system having a radius of one-hundred-fifty kilometers and centered on their nation's capital.) ⁷⁵ It was contended by the officials who drew up the treaty that the thought of mutual destruction in an all out exchange of nuclear weapons, without the employment of ABMs, would suffice in averting Armageddon. The President was intent on changing this concept.

Early in his first term, President Reagan called on U.S. scientists to devise a means of intercepting and destroying the attacking missiles and their warheads in mid-flight. "Let us go back to the old-fashioned, reliable kind of defense," he said, "a defense that puts a shield between the United States and its enemies to protect us from their deadly weapons." ⁷⁶ (By all accounts, the armed services were not enthralled by the president's speech. But soon it was realized in the defense policy apparatus that a variety of objectives could be pursued under Star Wars: creating a new impetus for military technology, badgering the Soviet Union, dominating outer space, and, for some, destroying arms control.) ⁷⁷

With President Reagan's authority to proceed, the Strategic Defense Initiative (SDI) was to go into full swing

based on a concept where a laser gun would be developed and then deployed in space, having direct line of sight to the Soviet missile fields, and being capable of destroying Soviet missiles and their warheads with the intense heat of a laser beam.⁷⁸ Provided SDI could be developed and deployed, America would have an advantage it had never had before: first-strike capability with a high degree of survivability from retaliation.

West Europeans received President Reagan's announcement of SDI with little if any fanfare. In fact, most governments were very unnerved that the President would make such a public announcement before further negotiations of the new defense concept had been talked over in full among the allies. Many hoped that the "hair-brained" notion of Star Wars would simply dissipate with time. But when President Reagan delivered his speech in March 1983 and when he was subsequently reelected to another term in 1984, it was realized that SDI would not blow away easily.

The West Europeans, and especially the French, were as cautious about the new defense proposal as some Americans were enthusiastic about it. It was the West Europeans, after all, who had welcomed the ABM Treaty of 1972 for all the reasons why BMD was opposed. The main benefit was seen as stabilization of the arms race and East-West relations generally, with a firm foundation for continuing detente.

Other specific reasons for Western European approval were:

1) The continued credibility of the British and French nuclear deterrents was enhanced. (Logically, if the West built a BMD the Soviets would too. France, with its unique force de frappe could scarcely hope to build enough submarine-launched ballistic missiles (SLBMs) and intermediate-range ballistic missiles (IRBMs) to saturate Soviet defenses.)

2) The U.S. insisted that Article IX of the ABM Treaty (which prevents the transfer of ABM technology to third world countries) would not prevent the transfer of offensive weapons technology.

3) The U.S. did not make itself less vulnerable to ballistic missile attack than its allies.⁷⁹

West Europeans scoffed at the thought of President Reagan taking the O.K. Corral into space, much less wanting allies to participate. They remained skeptical about a program that would alter their present security and were concerned whether or not the United States would provide sufficient Western European defense once the SDI program was complete: It had been expressed that the United States would place the bulk of SDI emphasis on long-range missile defense to keep U.S. borders safe, while negligible concern would be directed to defense against short and medium-range missiles, leaving West Europe ungaurded by the American space defense. To prompt maximum Western European support for the SDI program, the United States had to direct itself

towards the defense against short and middle-range nuclear missiles too. In light of all the "ifs" and "buts" of Star Wars, the French foreign minister, Claude Cheyson, urged the United States to drop the mistaken idea of a "Maginot Line in Space."⁸⁰

Therefore, in an effort to coalesce allied support for SDI, in March 1985 the United States Secretary of Defense, Caspar Weinberger, was charged to communicate with U.S. allies by letter, urging their participation in the program. Weinberger said in his letter:

"As you know, the purpose of the SDI is to determine whether there are cost-effective defensive technologies that could enhance deterrence and increase stability. Because security is inextricably linked to that of our friends and allies, we will work closely over the next several years with our allies to ensure that, in the event of any future decision to deploy defensive systems (a decision in which consultation with our allies would play an important part), allied, as well as United States, security against aggression would be enhanced. Moreover, the SDI program will not confine itself solely to an exploitation of technologies with potential against ICBMs and SLBMs, but will also carefully examine technologies with potential against shorter-range ballistic missiles.

If your nation is interested in exploring possible cooperative efforts or contributions, I would ask, as a first step, that you send me, within 60 days, an indication of your interest in participating in the SDI research program and of the areas of your country's research excellence that you deem most promising for this program."⁸¹

But for some West Europeans, this letter entrenched further reluctance in joining the SDI program because of what was perceived to be a lack of diplomatic courtesy and sensitivity on the part of the United States. It was⁸² regarded as being pushy. And rather than considering the letter as a gesture of good faith, many West Europeans felt they were being bullied by it.

Another obstacle that caused Western European governments apprehension to participate in SDI was the Treaty on the Non-Proliferation of Nuclear Weapons, signed by the U.S. and the Soviet Union in 1968, and which since has attracted over⁸³ 120 signatories. U.S. officials admitted that clauses in the treaty forbidding the exchange of nuclear technology for military purposes - or cooperation on research aimed at developing such technology - between states that possess nuclear weapons and those that do not, could restrict access to certain key technologies for European countries⁸⁴ participating in the research.

Although French President Mitterrand strongly endorsed the U.S. Cruise and Pershing missiles that were deployed in Europe in the mid 1980s, he was strictly opposed to the deployment of space weapons, arguing that it would lead to a⁸⁵ new arms race. However, he made it clear that he had no objections to the Americans simply carrying out research into⁸⁶ SDI.

During the economic summit in Germany on 4 May 1985, President Mitterrand bluntly refused President Reagan's invitation to take part in American space defense research. Mitterrand presented himself not just as a defender of French interests but those of West Europe as well. "Europe must mobilize itself around a great project that is truly European", he declared, as he went on to explain why he favored research into a European rather than an American
87
Star Wars project.

President Mitterrand was not alone in his disapproval of Star Wars. When the European peace movement admitted defeat in its struggle to prevent deployment of cruise and Pershing II missiles on European soil, they shifted their efforts and concentrated on keeping Western Europe out of
88
President Reagan's SDI. For example, on 8 April 1985, almost 350,000 people took part in marches throughout West
89
Germany against Star Wars.

And, although American public opinion of SDI has seesawed back and forth, in favor of it one day and in opposition to it the other, after the Reykjavik Summit popularity for SDI rose. "It cannot have been part of Gorbachev's intention to entrench SDI, but the strength of his opposition to it seems to have convinced Americans that they have something worth keeping," so read an article in
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The Times (London) newspaper.

Other American opposition towards Star Wars was seen in the spring of 1985. Physicists at Cornell University and the University of Illinois (Champaign-Urbana) independently began to circulate petitions calling the SDI program "deeply misguided and dangerous" and asking physicists, mathematicians, computer scientists, and engineers to pledge not to solicit or accept IST (Innovative Science and Technology created by the Strategic Defense Initiative Organization in 1984) contracts.⁹¹ 57% of the faculty in the nations top twenty physics departments signed the pledge, marking the first research boycott against a specific weapons system to be truly national (U.S.) in scope.⁹²

In May 1985, in the midst of debate over SDI, President Mitterrand unveiled plans for an ambitious new scheme, popularly known as Eureka (European Research Coordination Agency). It was introduced to link a series of international collaborative research projects in different areas of advanced technology.⁹³ Here, President Mitterrand was not only offering his fellow Europeans an option to Star Wars, but he was able to manifest France's technological prowess, and himself as the modern technological president that he prides himself to be.⁹⁴ But the general reaction in many European capitals was skeptical towards Eureka. "It

came out of the blue, and struck us at the time as an odd thing to do," said one official in Britain's cabinet⁹⁵ office.

Actually, Eureka should not have come as a surprise at all. Less than a year after President Reagan's announcement of SDI, President Mitterrand, in February 1984, proposed European cooperation in a space-based military reconnaissance/observation program, which eventually could lead to European development of a manned military space station.⁹⁶ "If Europe were capable of launching its own manned space station that permits it to observe and react to all threats, then Europe would make a big step for its own defense," he said.⁹⁷

In any case, it was evident that talk of the United States' SDI program and the technological advances expected to ensue left many Europeans with the sense of missing the boat. But implications of limitations on high-tech transfer found in the Non-Proliferation of Nuclear Weapons Treaty provided President Mitterrand a principal reason to declare that France - unlike Germany, Great Britain, and Italy - had no intention of participating in SDI and, thus launched the European program Eureka as an alternative.⁹⁸

It is not surprising that France took the lead in opposition to America's SDI. Again, France had more at stake than its European counterparts. As stated before, it

has consistently spent more on space activities than other Western European nations. In 1986, for example, French space expenditures were over \$900 million: West Germany, \$600 million; Italy, \$300 million; and England, \$200 million.⁹⁹

Certainly, President Mitterrand was anxious to plug the "technology gap", which was said to be widening between Europe and the United States despite achievements such as the ESA and Ariane. Illustrating the urgency placed on this issue is an excerpt from the 15 July 1985 article in Aviation Week and Space Technology magazine that described the release of a French-government Eureka report as stating:

"Advances achieved in this project (Eureka) ultimately could be applied to aircraft engines and systems for orbital space stations. To meet the technical challenges of the end of this century, Europe must rapidly master the know-how that soon will be at the heart of the third industrial revolution. This is particularly true given the considerable efforts being made in the U.S. and Japan. The choices we make in the near future will either weaken Europe's potential in advanced technologies or bring about a technological renaissance."¹⁰⁰

In September 1985, President Mitterrand took the lead in promoting Europe's role in space and other advanced technologicis when he made two politically important visits as described in the 12 September 1985 issue of The Times (London) newspaper:

"Widespread approval from the right and

left has greeted Mitterrand's surprise announcement of his planned visit this week to the French nuclear test site on Mururoa atoll. He will be the first French president to visit the site since General de Gaulle in 1966. He will stop off in the French Overseas Department of French Guiana enroute to Mururoa to observe the launch of the fifteenth Ariane space rocket at Kourou."101

Mitterrand's trip was well timed. With the West German spy scandals taking place only a month earlier (August 1985), and with reports that the scandal had so shaken America's confidence in Western Europe's ability to protect sensitive allied information that it was certain to lead to a clampdown on sharing top secret data about SDI, ¹⁰² the opportunity for effective European-research propaganda was at hand and Mitterrand took it.

After recovering from the initial shock of President Mitterrand's proposal, and in light of possible clampdowns on exchange of data from SDI by the U.S., other West European countries began to respond more positively to the thought of increased research through the Eureka project. It was felt that it could be a unifying catalyst to bring the European Economic Community out of its agriculturally-entrenched mode of thinking and into a prosperous and competitive world of high technology with strong ties to space research. It was suggested that working together towards a common goal would not only bring about Western European unity, but, that Europe might find itself bridging

the gap of high technology with the United States. Again, autonomy in Western European space programs - the capability for Europe to ultimately exercise the freedom to develop, launch, and operate its own satellite and space systems without reliance on others, particularly the United States - was still an enthusiastically received notion. This desire for autonomy was only strengthened from the bitter experience of Spacelab, which European countries built for \$920 million as their part in the Space Shuttle program but now must hire from NASA at commercial rates whenever they want to use it.

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In spite of this popular enthusiasm for space and technological independence from the United States, securing West European unity in pursuit of high technology advancements through space research was not easy. For one reason, on May 1985 the Soviet Defense Minister acknowledged that the Soviet Union was conducting military research in space, but insisted it was for peaceful purposes. Many West Europeans therefore found SDI justifiable in order to keep the superpowers in balance. Also, from the onset of the Eureka proposal, West European countries were skeptical of each others' interests in Eureka. For instance, there was concern that Germany and Italy would try to dominate the program because of their strong alliance in and command of the up-and-rising Columbus project (a project that calls for

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Europe's launch of a manned free-flying laboratory in 1999) which would presumably have great influence on Eureka and vice versa.¹⁰⁵ Others felt at a disadvantage in pursuing a significant role in Eureka after the Paris Air Show in June 1985 when President Mitterrand described Eureka as "a Franco-German idea".¹⁰⁶

Besides the perception that some countries would gain the upper hand in Eureka, there were other factors that made securing support for it difficult. For example, West Germany was torn between its strong desire to have access to the new technology and its eagerness not to upset the French.¹⁰⁷ But German companies were swayed towards supporting SDI, assuming that affiliation with the U.S. program would have a greater chance of pushing their high technology to its limits (for example, in fields such as lasers and space vehicles).¹⁰⁸ They were also convinced that SDI would draw more of a market because of its greater financial backing.¹⁰⁹

Because Chancellor Kohl did not discourage German interest in SDI he did in fact upset the French. As a consequence, "Herr Kohl has been depicted as the first West German Chancellor to get on really bad terms with Paris since de Gaulle and Adenauer laid it down in the early 1960s

that friendship between the Fifth Republic and the Federal Republic was vital to both and was what West European unity was really about."¹¹⁰

Chancellor Kohl's tacit support of SDI, however, did not mean disregard for Eureka. On the contrary, besides support from the majority of Herr Kohl's conservative CDU-government supported Eureka, and there was also support from prominent members of the opposition Social Democrats, in particular former Chancellor Helmut Schmidt.¹¹¹ Nevertheless, France felt there was still too much support shown for the U.S. program and attempted to sever any existing German ties with SDI by playing on three strong arguments:

- 1) Whether it likes it or not, West Germany's future security is tied to that of Europe which in turn depends on its joint technological strengths.
- 2) There is growing disillusionment with the unfulfilled promises of previous collaborative technological projects between Germany and the U.S., epitomized by the costly experience of Spacelab.
- 3) There is the possibility, being raised in public by the German defense minister, that Europe might launch its own space-based strategic defense system complementary to SDI but aimed at defending against nuclear bombers and short and medium-range missiles, including cruise.¹¹²

Supplementing this last point, a proposal in 1985 was circulated in Paris that closer French-German links in the twin fields of advanced technology and military planning

could provide the basis for a joint security strategy under which France would continue to maintain its force de frappe (offering explicitly to include Germany under its nuclear umbrella) while, in return, Germany would become a strategic power through the separate route of space technology.¹¹³

Germany was not the only country to make initial "waves" for Eureka; England for instance, was concerned at first, that joining Eureka would jeopardize its preferential access to defence information that results directly from its special relationship with the United States.¹¹⁴ England, however, soon grew warm to Eureka because of fears of SDI gaining too much support from English companies and possibly resulting in another "brain drain". And in the summer of 1986, Prime Minister Thatcher showed her support for Eureka when she said that if collaboration fails "we face the stark prospect that the United States and Japan will monopolize world markets in high technology."¹¹⁵

There were, however, other Western European countries that supported Eureka from the start because it was promoted as a civilian project intended to achieve civilian goals, unlike SDI which is directly oriented to military defense. Austria, for example, concerned with its political neutrality expressed support for Eureka.¹¹⁶

There is however, some debate as to the true identity of Eureka, be it a truly civilian or a partially military

program:

Six areas outlined for research in April 1985 - optoelectronics, new materials (the development of an advanced industrial turbine that could incorporate ceramic/metal and ceramic/ceramic technologies), super computers, lasers and particle beams, artificial intelligence, and high-speed microelectronics-closely mirrored the technologies receiving attention under SDI.¹¹⁷

Despite the many problems, by November 1985, France had secured endorsements for Eureka from eighteen separate European countries, including all members of the EEC.¹¹⁸

This, however did not preclude West European affiliation with SDI as well. Despite French argument against the American space defense program, Great Britain and West Germany endorsed SDI in December 1985 while France, Denmark, Greece, and Ireland rejected the idea of formal governmental affiliation.¹¹⁹ France has, however, left one door open; it will allow private industrial participation.

Nevertheless, of the 72 projects identified under the Eureka program, by the summer of 1986, British companies committed themselves to participate in 30 of them; and although West Germany linked itself to only 4 of these projects as of July 1986, it is expected to boost that number to 19 because of the German minister for research and technology agreeing to make over \$200 million available over the next 10 years.¹²⁰ France, as would be expected, has made itself the largest supporter of Eureka by participating

in almost 50 of the approved projects.¹²¹ Further evidence of its success lies in the fact that almost 2 years after President Mitterrand introduced Eureka, membership was capped at 19 nations and Eureka has had to turn away¹²² inquiries from another 6 governments.

Once again, in the face of the American challenge in space and high technology, West Europe has shown its ability to unite as a formidable competitor. And once again, it has been France that has taken the lead.

Conclusion

Although the West Europeans stepped into the 1970s somewhat gingerly in the wake of their degenerating European Launcher Development Organization, the merging of that organization with the European Space Research Organization to develop the European Space Agency gave new birth to the Western European rocket and space effort. And with the emergence of ELDO's successor, Ariane, the Europeans claimed a duo that soon came to rival the American Space Shuttle program in commercialized space. The once closed satellite-launcher enterprise dominated by the Americans, opened to the Europeans who could offer satellite launches at a much lower price. And the appeal of the lower cost attracted customers from all over the world to include American

companies once used to contracting satellite business with the United States government. Therefore, not only have the Europeans attained a certain degree of space autonomy from the United States, but they have also embarked on an expanding and lucrative market of satellite launching, worth billions of dollars.

The West European trend of space and high technology successes continued in the 1980s when French President Mitterrand introduced the European Research Coordination Agency in retaliation to President Reagan's announcement of the American Strategic Defense Initiative. Despite some Western European support for SDI, the overwhelming European endorsement of Eureka presents itself as yet another example of increasing European cohesiveness in space and high technology activities that places West Europe in a good position for even more ambitious undertakings, such as a European spaceplane and space station that will again compete with the United States in other areas of commercialized space, and possibly in space defense.

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Conclusion

Over the last 60 years, rocketry and space research and development have played an increasingly important role in the political, economic, and social areas of West Europe. In its embryonic stages, under the tutelage of civilian researchers, rocketry and space was rather insignificant, in itself, as a visionary and theoretical field of research that was supported by relatively meager funds. But when the Nazis took control of all rocket research and gave development of the V2 rocket top priority during World War II, adequate funding and materials were made available to build Hitler's panacea weapon that shot through space and fell to earth at 2000 miles per hour. But because of consequential differences among factions of German society, because of the capricious nature of the Fuehrer, because of the sophistication of the project, and, because of the allied invasion, the V2's strategic potential was never realized. Nevertheless, in terms of scientific achievement, the V2 rocket was the culmination of years of theory and testing and provided the base from which all modern rocketry and space exploration stems.

Towards the close of the war, both Americans and Russians captured large stocks of the V2 rockets that they later used in their own rocket and space research programs.

Actually, for several years after the war the V2 took over as the primary vehicle for American rocketry and space research until stocks were depleted. The Russians also used the V2 rocket in their research that eventually led to their routine testing of intermediate range ballistic missiles by 1955 and to the ultimate development of their intercontinental ballistic missile and the first artificial earth satellite, Sputnik, by 1957.

The Soviet successes in rocketry and space put another layer of ice on the Cold War and marked the beginning of the "space race". In particular, the flight of Sputnik caused a change in world opinion that could not be ignored. Opinion polls taken in West Europe revealed that the perception of America's scientific and military superiority had been substantially shaken and that Europeans were being drawn to a more neutralist military position that favored the withdrawal of American troops from European soil.

The Americans quickly countered to close the "satellite gap" in order to shore up prestige and military strength by investing billions of dollars into their own program of rocketry and space research. These funds created many new jobs in America that lured a large number of scientists and engineers from West Europe, heightening a somewhat anti-American mood among some Western European leaders that caused them to take countermeasures.

By the early 1960s, the West Europeans, having recognized the economic and social impact of the rocketry and space field, started their own space program to compete against the Americans who were perceived as attempting to envelop West Europe in their economic superiority in order to gain political dominance. Therefore, with strong support from the British and French, the European Launcher Development Organization and the European Space Research Organization were established by the mid-1960s. But because of a lack of organization and communication between the two organizations, and because of independent national interests, the quasi-integrated ELDO was ineffective and fell just short of total collapse.

But, in the 1970s, while American-government funding for space research was in decline after the determined Apollo years, the West Europeans continued to increase their expenditures on developing a legitimate rocket and space program because of their continued belief that neither the Americans nor the Russians would really help the Europeans in space activities that would compete undesirably with the superpowers. Therefore, in 1975 the European Space Agency was established to promote cooperation among European states in the fields of space research and technology. To accompany the ESA, the Ariane rocket program was created. Together they formed the nucleus of a truly

integrated rocketry and space effort that has provided the Europeans considerable space autonomy while allowing them to compete with the United States in the lucrative satellite-launching business worth billions of dollars.

Again in the 1980s, the Europeans asserted themselves in their quest for space and high technology autonomy when French President Mitterrand countered the American proposal for European cooperation in President Reagan's Strategic Defense Initiative with his introduction of the European Research Coordination Agency. Despite a good number of West European governments endorsing SDI, Eureka received unanimous support from the twelve European Community countries and by 1987 membership was capped at 19 nations.

Together with the ESA and Ariane, the Europeans have formed a space triad with the addition of Eureka. From this triad, West European rocketry and space programs are planned to continue, based on the ESA's decision in 1985 that gave the go-ahead for the development of the new rocket booster, Ariane 5, that will place the future European spaceplane, Hermes, into orbit to build and service the European space station. Along with these ambitious plans have been hints of a European space defense system, primarily discussed by the French and Germans. Altogether, these add up to a significant space effort that will compete further with the United States and other countries inclined to venture into

the space and high technology fields.

But it is now that several questions come to mind concerning Western European expansion in space, for instance: What is the ultimate European goal in space? Is it simply to achieve space parity with the United States, and the Soviet Union, or do the Europeans seek to dominate space for commercial and military gains? Is it possible that the Europeans would use their research in lasers and particle beams to develop space weapons as a means to effect political goals? Or do they merely intend to use space as a peaceful means to bring about further European integration?

In the last 15 years, the Europeans have in fact used space to bring about greater unification and economic achievement. Through these successes, European governments have become more inclined to unite in support of other space-related ventures, taking over a larger percentage of financing space activities, once almost solely in the hands of private business. With this rise in cooperative government backing, the possibilities have been enhanced for increased discussion among European governments for the promotion of a unified European space defense. This is especially true in view of the American call for greater defense burden sharing from its allies and talk of U.S. troop reductions if not total troop withdrawal from the

European theater. Consequentially, it is not unreasonable for the Europeans to seriously consider expanding their commercial role in space to that of a military nature.

With America leaning more each day to the Pacific rim in public and private affairs, with East-West relations warming, and with the Europeans scheduled to embark on even greater cooperation towards integration in 1992, the time seems ripe for the Europeans to assert themselves in world politics. Since space has been one of the mediums used for such purposes in the past, there seems to be no reason why it could not be used again. In any case, the emergence of West Europe as a space power presents interesting possibilities for future world affairs.

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